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Engineering Design File

Streamlined Risk Assessment for the CPP-603 EE/CA

Idaho National Engineering and Environmental Laboratory

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Building CPP-603A in the southern part of INTEC will be deactivated and decontaminated by the VCO/DD&D service teams. The primary objectives of this streamlined risk assessment are to (1) show whether or not leaving the currently estimated contaminant inventories in place would be acceptable, and (2) calculate the amount of waste that can be left in CPP-603A without posing an unacceptable risk or hazard to human health. For this report, allowable residual contaminant (ARC) inventory is the term used to represent the residual inventory that can remain in the CPP-603A facility after closure without a predicted future aquifer concentration above some limiting value.

Based on this streamlined risk assessment, grouting of the basins and canals while leaving all current source inventory in place results in predicted groundwater concentrations that meet the required performance criteria. For groundwater, the performance criteria is to prevent migration of contaminants from the CPP-603A basins that would cause the Snake River Plain Aquifer, located outside the INTEC security fence, to exceed a cumulative carcinogenic risk level of 1 x 10^{-4}, a total hazard index of one, or applicable State of Idaho groundwater quality standards in 2095 and beyond.

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ACRONYMS

AACC	acceptable ambient concentrations for carcinogens
ARAR	applicable or relevant and appropriate requirement
ARC	allowable residual contamination
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	contaminant of potential concern
CPP	Chemical Processing Plant
DOE	U.S. Department of Energy
EA	environmental assessment
EDF	engineering design file
EPA	U.S. Environmental Protection Agency
FRSF	Fuel Receiving and Storage Facility
ICDF	INEEL CERCLA Disposal Facility
IDAPA	Idaho Administrative Procedures Act
IFSF	Irradiated Fuel Storage Facility
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
MCL	maximum contaminant level
MEI	maximally exposed individual
NA	not available
NCRP	National Council on Radiation Protection
NE-ID	U.S. Department of Energy Idaho Operations Office
NEPA	National Environmental Policy Act
O&M	operations and maintenance
OU	operable unit

PEWE	Process Equipment Waste Evaporator
RCRA	Resource Conservation and Recovery Act
RI/BRA	remedial investigation/baseline risk assessment
SF	slope factor
SHADO	small high-activity debris object
USC	United States Code

Streamlined Risk Assessment for the CPP-603 EE/CA

1. INTRODUCTION

Building CPP-603A in the southern part of the Idaho Nuclear Technology and Engineering Center (INTEC) will be deactivated and decontaminated by the VCO/DD&D service teams. The location of the INTEC and CPP-603A facility are shown in Figures 1-1, 1-2, and 1-3. CPP-603A is referred to as the Fuel Receipt and Storage Facility. This EDF was written to support the CPP-603A streamline risk assessment in the engineering evaluation/cost analysis (EE/CA) for the CPP-603A (DOE/NE-ID 2004). This is a CERCLA non-time critical removal action at the Idaho Nuclear Technology and Engineering Center (INTEC).

The primary objectives of this streamlined risk assessment are to (1) show whether or not leaving the currently estimated contaminant inventories in place would be acceptable, and (2) calculate the amount of waste that can be left in CPP-603A without posing an unacceptable risk or hazard to human health. For this report, allowable residual contaminant (ARC) inventory is the term used to represent the residual inventory that can remain in the CPP-603A facility after closure without a predicted future aquifer concentration above some limiting value.

This report does not directly address the potential for cumulative risk, however, a conservative evaluation of the potential contribution from contaminated soils in the vicinity of CPP-603A has been documented in "Soil Contamination Groundwater Pathway Risk Assessment for the CPP-603A EE/CA" (EDF-4489). Base on the evaluation the contaminated soils are not predicted to be a significant risk contributor to the total risk from CPP-603. The remainder of this section will be devoted strictly to CPP-603.

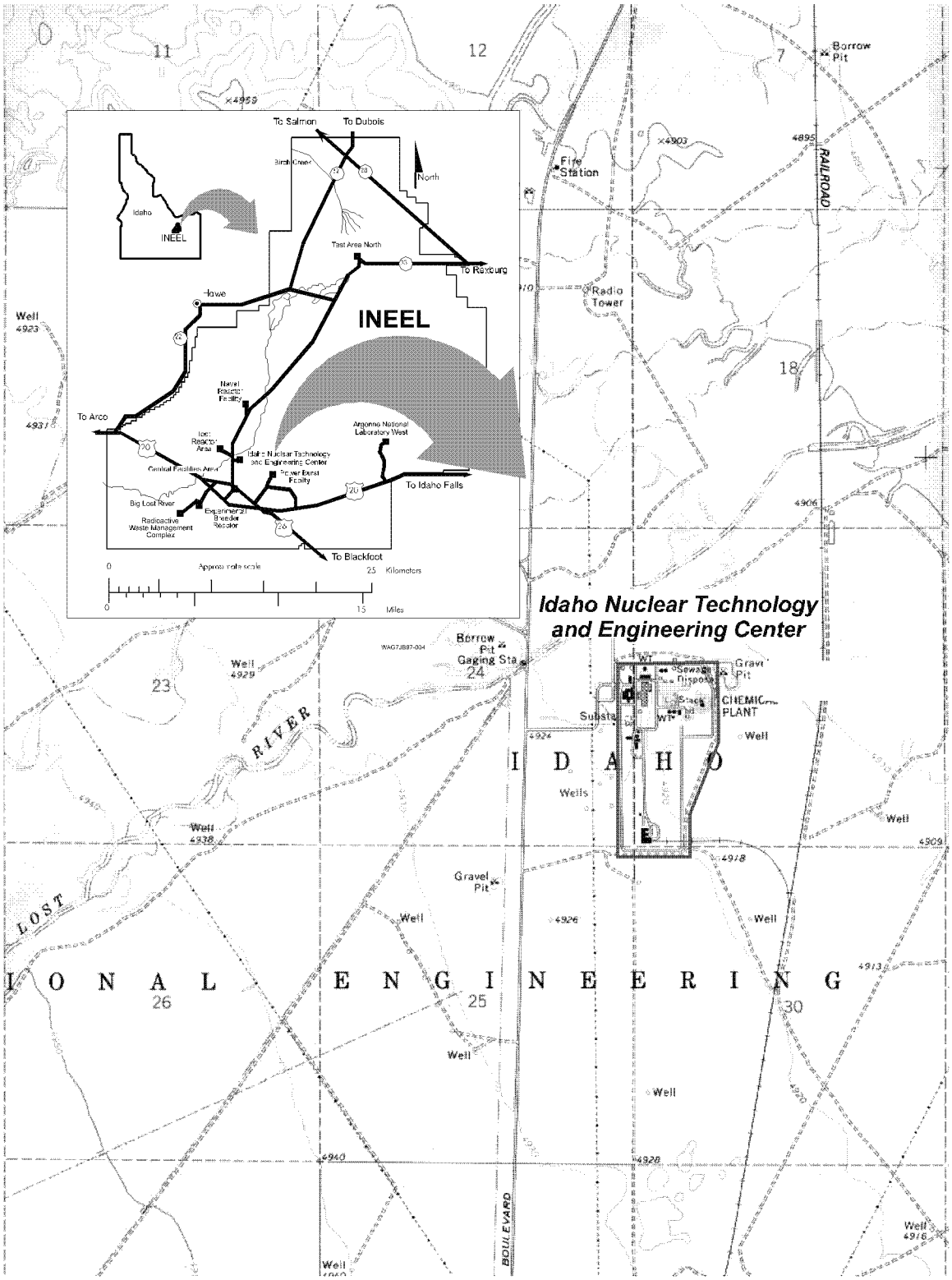

Figure 1-1. Location of the Idaho Nuclear Technology and Engineering Center and the Idaho National Engineering and Environmental Laboratory.

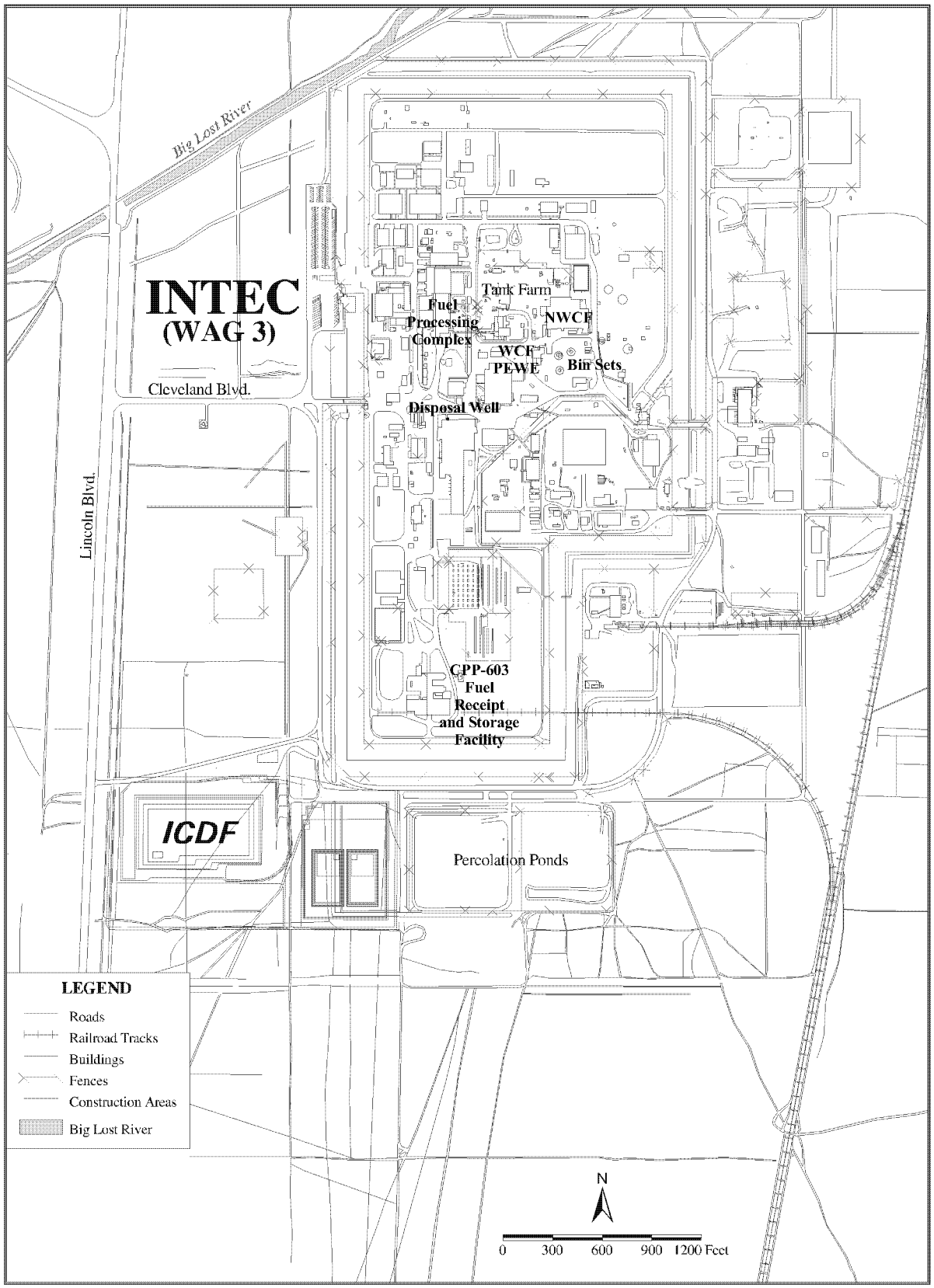

Figure 1-2. Plan view of the Idaho Nuclear Technology and Engineering Center.

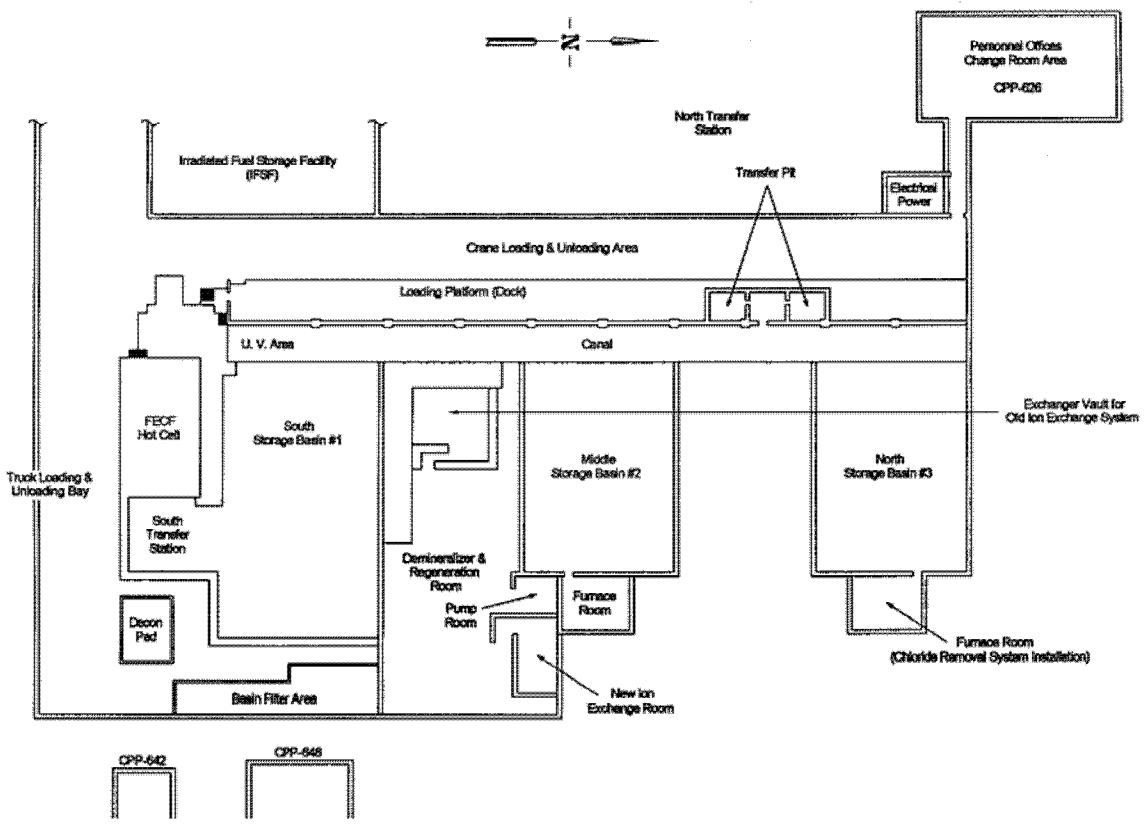

Figure 1-3. Plan view of a portion of the CPP-603 building, showing the basins.

2. ANALYTICAL DATA AND BASIN INVENTORY

The characterization of contaminants in the CPP-603A basins has been a topic of interest for some time. In 1993, sludge was sampled from the south basin. In 1994, sludge samples were collected from locations throughout the three basins. Four composite samples were analyzed. The analysis included both radionuclides and nonradionuclides. Analyses for bulk density or particle size distribution were not performed. The results of this sampling and analysis program were used in previous CPP-603A risk assessment analyses (EDF-1962 and EDF-3684).

Laboratory analyses of the 1993 and 1994 samples indicated the presence of silicon, aluminum, and iron as major constituents. The high proportion of silicon and aluminum seems to indicate that a large fraction of the sludge is soil particulate that entered the building due to wind and weather events. Sample analyses did not indicate the presence of a significant amount of neutron poisons such as boron, cadmium, or chlorine. However, sampling results identified cadmium in a concentration above 1 mg/kg. It was estimated that approximately 5.6 kg (12.4 lb) of U-235 was contained in the sludge distributed over the basin floor area (Demmer 1996a, Demmer 1996b).

In order to develop a more accurate estimate of the radionuclide inventory in the basins, a number of studies have been performed in recent years. The following sections summarize the potential contaminant sources in the CPP-603A basins and describe the inclusion of the inventory in the EE/CA streamlined risk assessment. The inventory has been divided into the following four waste streams.

Section 2.1 – sludge materials on the floor of the basins

Section 2.2 – contaminants dissolved in the water

Section 2.3 – debris distributed across the basins with particle size greater than 0.125" diameter.

Section 2.4 – discrete objects significantly larger than 0.125" diameter.

2.1 Sludge Materials on the Floor of the Basins

In order to obtain a representative profile for the radionuclides in the basins, samples of CPP-603A sludge were taken in October, November, and December of 2002. The sludge sampling effort was intended to better characterize the readily suspended particulate, therefore, the sampling screened out debris objects (Section 2.3) with a diameter greater than 0.125 in.

An engineering design file (EDF) entitled "CPP-603 Radionuclide Sample Results" (EDF-4235) contains the estimate of radiological material inventories that currently remain in the sludge in the CPP-603A basins based on the 2002 sampling (see Table 2-1), thereby updating earlier estimates (Demmer 1996a). The analysis results represent the solid and water in the sludge.

As discussed in EDF-4235, the concentrations found in the new sludge samples are considerably higher than the concentrations found in the 1996 samples. However, the depth and density of the sludge were shown to be substantially lower than the values assumed for the 1996 analysis. The total inventory of nuclides estimated for the 1996 and 2002 sampling generally are within a factor of two. In particular, based on the 1994 sampling there are 5.6 kg of U-235 in the basins and based on the 2002 sampling, there are 6.96 kg of U-235 +/- 3.2 kg.

Table 2-1 lists the nuclide inventories used for this analysis, based on the sampling results presented in EDF-4235. Nuclides that were analyzed and had one or no detections out of the 20 sludge samples are noted in the table. These nuclides are assumed to be present in insignificant quantities and are

Table 2-1. The CPP-603A nuclide inventory based primarily on the 2002 sludge samples and 2003 water samples.

Nuclide	Radioactive Decay Half-life Years	Sludge and Water Inventory		Estimated Total Inventory	
		Current (Ci)	After 500 Years (Ci)	Current (Ci)	After 500 Years (Ci)
Ag-108m	**1.27E+02**	**<1.65E-01 (1 detection)**	**<1.08E-02**	**<3.30E-01**	**<2.16E-02**
Ag-110m	**6.84E-01**	**<6.70E-01 (nondetect)**	**0**	**<1.34E+00**	**0**
Am-241	4.32E+02	2.25E-02	1.01E-02	4.50E-02	2.02E-02
C-14	5.73E+03	3.13E-04	2.94E-04	6.26E-04	5.88E-04
Ce-144	**7.80E-01**	**<1.87E+00 (nondetect)**	**0**	**<3.74E+00**	**0**
Cm-244[a]	1.81E+01	7.00E-04 [a]	3.38E-12	1.40E-03	6.76E-12
Co-58	1.94E-01	1.31E+00	0.00E+00	2.62E+00	0.00E+00
Co-60	5.27E+00	5.66E+01	0	1.13E+02	0
Cs-134	**2.06E+00**	**<4.36E-01 (nondetect)**	**0**	**<8.72E-01**	**0**
Cs-137	3.02E+01	8.70E+01	8.92E-04	1.74E+02	1.78E-03
Eu-152	1.36E+01	2.74E+02	2.34E-09	5.48E+02	4.68E-09
Eu-154	8.80E+00	1.38E+02	1.09E-15	2.76E+02	2.18E-15
Eu-155	4.96E+00	8.91E+00	0	1.78E+01	0
H-3	1.23E+01	9.39E-02	5.83E-14	1.88E-01	1.17E-13
I-129	1.57E+07	7.77E-06	7.77E-06	1.55E-05	1.55E-05
Mn-54	**8.55E-01**	**<4.72E-01 (nondetect)**	**0**	**<9.44E-01**	**0**
Nb-94	**2.03E+04**	**<4.18E-01 (nondetect)**	**<4.11E-01**	**<8.36E-01**	**<8.22E-01**
Nb-95	9.58E-02	7.55E-01	0	1.51E+00	0
Np-237[a]	2.14E+06	5.00E-03[a]	5.00E-03	1.00E-02	1.00E-02
Pu-238	8.77E+01	2.76E-01	5.30E-03	5.52E-01	1.06E-02
Pu-239[b]	2.41E+04	2.01E+00	1.98E+00	4.02E+00	3.96E+00
Pu-240[b]	6.56E+03	2.01E+00	1.91E+00	4.02E+00	3.82E+00
Ra-226	**1.60E+03**	**<6.65E+00 (nondetect)**	**<5.35E+00**	**<1.33E+01**	**<1.07E+01**
Ru-103	**1.07E-01**	**<4.05E-01 (nondetect)**	**0**	**<8.10E-01**	**0**
Ru-106	**1.02E+00**	**<1.01E+00 (nondetect)**	**0**	**<2.02E+00**	**0**
Sb-125	**2.73E+00**	**<3.89E-01 (1 detection)**	**0**	**<7.78E-01**	**0**
Sr-90[c]	2.91E+01	2.09E+01	1.41E-04	4.18E+01	2.82E-04
Tc-99	2.13E+05	6.26E-04	6.25E-04	1.25E-03	1.25E-03
Th-228[a]	1.91E+00	1.50E-02 [a]	0	3.00E-02	0
U-234	2.45E+05	3.48E-01	3.48E-01	6.96E-01	6.96E-01
U-235	7.04E+08	1.51E-02	1.51E-02	3.02E-02	3.02E-02
U-236	2.34E+07	5.51E-03	5.51E-03	1.10E-02	1.10E-02
U-238	4.47E+09	2.39E-03	2.39E-03	4.78E-03	4.78E-03
Zn-65	**6.68E-01**	**<7.39E+00 (1 detection)**	**0**	**<1.48E+01**	**0**
Zr-95	1.75E-01	9.85E+00	0	1.97E+01	0

a. In the 2002 sampling, Cm-244, Np-237, and Th-228 were not analyzed. Therefore, the results of the 1996 sampling are used. In the 2002 sampling, "other alpha" is listed as 1.95E-3. This is likely Np-237; however, because it was not specifically analyzed, the more conservative 1996 number was used.

b. The combination of Pu-239 and Pu-240 was reported together under Pu-239. For purposes of this study, it is conservatively assumed that the reported activity is the activity of each nuclide. The inventory of Pu-239/240 is overestimated by a factor of two, but does not influence the results of the analysis.

c. Strontium was reported as total strontium. It has been assumed that the strontium was all Sr-90. The inventory for nuclides that were not detected or only detected in one out of 20 samples is listed as "less than."

not carried forward in the analysis. The inventories after 500 years of radioactive decay also are shown in Table 2-1, since one of the modeling cases assumes the recommended removal action alternative is implemented and that the CPP-603A facility will be filled with grout and will be essentially impermeable to water for the first 500 years. Note that 13 of the 35 nuclides in Table 2-1 will essentially decay away in place, during the 500 years. In Table 2-1, the best estimates are used for the sludge inventory, but the uncertainty is conservatively added into the estimated total inventory (also shown in Table 2-1), which could potentially increase the sludge inventory by about 46%. The estimated total inventory includes other sources as well, as described in Sections 2.2 through 2.4.

Since there were no analyses of the nonradionuclides in the 2002 sampling, the sludge inventory from the 1994 sampling is used for this report. The information was summarized in EDF-1962, "Transport Simulation Approach for the Risk Assessment for Deactivation of INTEC Plant Building CPP-603," and EDF-3684, "Acceptable Residual Inventory Calculations for CPP-603." The inventory for the nonradionuclide contaminants of concern is shown in Table 2-2.

2.2 Inventory Dissolved in the Water

For the solids analyses used to estimate contaminant concentrations in the sludge (Section 2.1), the fusion method was used. In the process, volatile contaminants were lost. Therefore, there was no analysis for C-14, H-3, I-129, and Tc-99 in the sludge analyses. Based on process knowledge, these nuclides are not expected to be present in large quantities in the CPP-603 basins. However, since these nuclides are generally contaminants of concern at the INTEC, estimates of their inventory are needed for the streamlined risk assessment.

C-14, H-3, I-129, and Tc-99 are generally soluble in water and assumed to be leached from the source and move through the environment with essentially no sorption to the soils. Assuming this is also the case in the CPP-603A basins, the inventory of C-14, H-3, I-129, and Tc-99 is in the water, not adsorbed in the sludge. In order to get estimates of the C-14, H-3, I-129, and Tc-99 inventory in the CPP-603A basins, four water samples were collected and analyzed in June 2003. In addition to the C-14, H-3, I-129, and Tc-99 analyses, the water analysis results included concentrations of Zr-95, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Eu-155, Sb-125, and Sr-90. For C-14, H-3, I-129, and Tc-99, the inventory shown in Table 2-1 is based on the water samples. The results are documented in EDF-4235. For nuclides with samples both in the water and sludge, the water contribution was not significant and the inventory shown in Table 2-1 is based on the sludge inventory.

The estimated inventory for C-14, I-129, and Tc-99 is not necessarily conservative because there could be some inventory in the sludge. However, the results shown in streamlined risk assessment indicate that the inventory estimated from the water is 350 times less than an inventory of concern. Soluble chemicals such as carbon, iodine, and technetium are going to exist primarily dissolve in the water, not the solid. Therefore, further sludge analysis for these nuclides is not necessary.

If the basin water is evaporated, the contaminants in the water will precipitate and will remain in the basin. It is possible that there is some relatively small amount of sorption of the C-14, I-129, and Tc-99, but this inventory is assumed to be a small contributor to the overall inventory. If the water is removed to the ICDF, PEWE, or a comparable facility, the majority of the inventory in the water should be removed from the CPP-603 basins.

Table 2-2. The CPP-603A nonradionuclide inventory based on the 1994 sampling and analysis of basin sludge.

Contaminant	Initial Estimated Inventory (mg)
Aluminum	3.89E+09
Arsenic	1.80E+06
Barium	1.91E+07
Beryllium	3.77E+04
Cadmium	2.31E+07
Chloride	7.85E+07
Chromium	7.22E+07
Lead	9.50E+07
Mercury	5.30E+01
Nickel	1.54E+06
Selenium	6.04E+05
Silver	3.85E+04
Uranium[a]	1.40E+07
Zinc	1.43E+09
Acetone	2.95E+05
Benzene	1.08E+04
Bromomethane	2.10E+03
2-Butanone	3.60E+03
1,2-Dichloroethane	3.30E+03
Methylene chloride	3.30E+03
4-Methyl-2-pentanone	3.50E+03
m- and p- Xylene	7.20E+03
o-Xylene	3.40E+03
Styrene	3.80E+03
Toluene	6.00E+03

a. From EDF-4235, "CPP-603 Radionuclide Sample Results"
CPP = Chemical Processing Plant
EDF = engineering design file

2.3 Debris Distributed Across the Floor of CPP-603A

Extensive radiological surveying has been conducted throughout the CPP-603A building. The results of the survey are documented in EDF-3535. Basin floor surveys of the north basin detected levels ranging from 100 to 900 mR/hr, basin floor surveys of the middle basin detected levels ranging from 100 mR/hr to 10.2 R/hr near the southeast corner, and basin floor surveys of the south basin detected radiation levels from 100 to 600 mR/hr. A floor survey of the transfer canal detected radiation levels from 100 mR/hr to 32 R/hr near the south end of the canal. Generally, radiation readings from the basins are approximately 5 to 15 mR/hr on the top of the basin and 100 to 150 mR/hr at the scum ring around the basin walls.

In order to estimate the U-235 inventory in the debris, the scanning results were used to calculate the presence of Cs-137 and then to infer from these measurements the mass of U-235. By estimating the mass of U-235, the inventory of the debris can be compared to the inventory in the sludge. As explained in Section 2.1, based on the 2002 sampling, the sludge contains 6.96 +/- 3.22 kg of U-235 or a conservative estimate of 10.18 kg. Based on the radiological surveying, the debris contains approximately 3.8 kg of U-235. Therefore, the debris inventory is assumed to be approximately 55% the best estimate of the sludge inventory of U-235 or 38% of the conservative estimate. For purposes of the streamlined risk assessment, it is assumed that the nuclide composition of the debris is the same as the nuclide composition of the sludge, and the inventory is increased accordingly.

2.4 Discrete Objects

Discrete objects were identified using spectrometry data from survey of objects found in the pool to estimate the total activity from discrete objects significantly greater than 0.125" in diameter. Fourteen discrete objects were identified, 13 are activated metals that are either end boxes or non-uranium bearing generic fuel objects and one is a small high-activity debris object (SHADO). The discrete objects are described in detail in EDF-4271.

The activated metals are not expected to contain any of the contaminants of concern for this streamlined risk assessment. However, the SHADO would be similar in makeup to both the contaminants in the sludge and in the debris. The SHADO is estimated to contain approximately 3 g of U-235, which is 0.04% of the estimated sludge inventory. This is an insignificant contributor to the overall nuclide inventory in the CPP-603 basins.

2.5 Basin Inventory Summary and Discussion

As discussed in the subsections above, nuclide specific inventories at the CPP-603A basins are available for the sludge and for C-14, H-3, I-129, and Tc-99 in the water. Details on the nuclide specific inventories can be found in EDF-4235. For debris over 0.125" in diameter (EDF-3535), which is distributed throughout the basins and larger discrete objects (EDF-4271), estimates of the mass of U-235 have been inferred based on radiological surveys that measure for Cs-137.

An estimated total inventory is needed for the streamlined risk assessment. For purposes of this estimate, it is assumed that the nuclide specific inventory from the sludge and water samples have the same nuclide composition as the debris and discrete objects of interest. Since estimates are available for the U-235 mass of each of the waste streams, the nuclide specific inventory is scaled up based on the relative U-235 mass to provide an estimate of the nuclide specific total inventory.

As discussed in the subsections above, the sludge is estimated to contain 6.96 +/- 3.22 kg of U-235, the debris is estimated to contain 3.8 kg of U-235, and the discrete objects are estimated to contain 0.003

kg of U-235. For this report it is assumed that the total amount of U-235 is 6.96 + 3.22 + 3.8 + 0.003 or approximately 14 kg of U-235. This is twice the estimated inventory of U-235 in the sludge. Therefore, the estimated total inventory is assumed to be twice the inventory in the sludge and water samples as shown in Table 2-1.

As discussed in Section 2.1, there were no analyses of the nonradionuclides in the 2002 sampling. The sludge inventory from the 1994 sampling was used for this report. The inventory for the nonradionuclide contaminants of concern is shown in Table 2-2.

3. CPP-603A RADIONUCLIDE CONTAMINANT SCREENING

The radionuclides that were detected in more than one of the 20 sludge samples were screened to a set of contaminants of concern using the National Council on Radiation Protection (NCRP) screening factors (NCRP 1996). The assumed intact life span of the grouted CPP-603A basins after final disposition is assumed to be 500 years. This assumption is based on similar assumptions in the *Idaho High-Level Waste & Facilities Disposition Final Environmental Impact Statement* (DOE-ID 2002). Complete failure is assumed at the end of the intact life span. Water will then move through the grouted waste material at the same rate it would move through native soil. Therefore, the radionuclide inventory screening uses the inventory after 500 years of radioactive decay.

As shown in Table 3-1, the nuclide inventories in the sludge were decayed for 500 years and then multiplied by the NCRP factors to give a measure of the expected contribution of each nuclide to the total dose. The screening criterion chosen is that any nuclide that contributes more than $1/1000^{th}$ (0.1%) to the total dose was retained as a contaminant of concern. However, as can be seen in Table 3-1, a number of mobile nuclides that are contaminants of interest at the INTEC would be screened at that level (C-14, I-129, and Tc-99). Since C-14, I-129, and Tc-99 are contaminants of general interest at the INTEC, they were included as contaminants of concern even though they failed the NCRP screening.

The 11 radionuclides defined as contaminants of potential concern (COPC) are in bold type and highlighted in yellow or blue in Table 3-1. The eight COPCs highlighted in yellow contribute over 99.8% of the total product. Of these, Pu-239 and Pu-240 contribute almost 90% of the total dose. In addition to the primary dose contributors, C-14, I-129, and Tc-99 are highlighted in blue and included as contaminants of potential concern because they have been identified as significant contaminants of concern in the aquifer at INTEC in related projects. Therefore, more detailed analysis was warranted.

Based on the screening dose factors, Pu-239 and Pu-240 appear to be the primary risk drivers. However, this screening does not take into account the effects of different transport times through the vadose zone for retarded contaminants and the ultimate impact on the predicted groundwater concentrations. For this reason, the potential contaminants of concern must be reevaluated with contaminant transport simulations.

Table 3-1. Radionuclide screening using the National Council on Radiation Protection screening dose factors.

Nuclide	Radioactive Decay Rate	Current Inventory	Inventory in 500 yrs		Screening Factor Table 3.2 NCRP 123	Inventory in 500 years (Bq) Times the NCRP Screening Factor	% Dose
		(Ci)	(Ci)	(Bq)	(Sv/Bq)	(Sv)	
Am-241	**4.32E+02**	**2.25E-02**	**1.01E-02**	**3.74E+08**	**8.40E-12**	**3.14E-03**	**0.21%**
C-14	**5.73E+03**	**3.13E-04**	**2.94E-04**	**1.09E+07**	**1.70E-11**	**1.85E-04**	**0.01%**
Cm-244	1.81E+01	7.00E-04	3.38E-12	1.25E-01	3.00E-12	3.76E-13	0.00%
Co-58	1.94E-01	1.31E+00	0.00E+00	0.00E+00	6.90E-18	0.00E+00	0.00%
Co-60	5.27E+00	5.66E+01	1.56E-27	5.76E-17	6.60E-12	3.80E-28	0.00%
Cs-137	3.02E+01	8.70E+01	8.92E-04	3.30E+07	1.40E-11	4.62E-04	0.03%
Eu-152	1.36E+01	2.74E+02	2.34E-09	8.67E+01	6.60E-12	5.72E-10	0.00%
Eu-154	8.80E+00	1.38E+02	1.09E-15	4.02E-05	5.40E-12	2.17E-16	0.00%
Eu-155	4.96E+00	8.91E+00	4.02E-30	1.49E-19	1.70E-13	2.53E-32	0.00%
H-3	1.23E+01	9.39E-02	5.83E-14	2.16E-03	3.10E-13	6.68E-16	0.00%
I-129	**1.57E+07**	**7.77E-06**	**7.77E-06**	**2.87E+05**	**2.00E-10**	**5.75E-05**	**0.00%**
Nb-95	9.58E-02	7.55E-01	0.00E+00	0.00E+00	7.00E-22	0.00E+00	0.00%
Np-237	**2.14E+06**	**5.00E-03**	**5.00E-03**	**1.85E+08**	**3.00E-10**	**5.55E-02**	**3.64%**
Pu-238	**8.77E+01**	**2.76E-01**	**5.30E-03**	**1.96E+08**	**7.90E-12**	**1.55E-03**	**0.10%**
Pu-239	**2.41E+04**	**2.01E+00**	**1.98E+00**	**7.33E+10**	**9.50E-12**	**6.96E-01**	**45.74%**
Pu-240	**6.56E+03**	**2.01E+00**	**1.91E+00**	**7.05E+10**	**9.40E-12**	**6.63E-01**	**43.55%**
Sr-90	2.91E+01	2.09E+01	1.41E-04	5.20E+06	3.60E-11	1.87E-04	0.01%
Tc-99	**2.13E+05**	**6.26E-04**	**6.25E-04**	**2.31E+07**	**1.30E-11**	**3.00E-04**	**0.02%**
Th-228	1.91E+00	1.50E-02	2.36E-81	8.72E-71	7.10E-13	6.19E-83	0.00%
U-234	**2.45E+05**	**3.48E-01**	**3.48E-01**	**1.29E+10**	**5.80E-12**	**7.46E-02**	**4.90%**
U-235	**7.04E+08**	**1.51E-02**	**1.51E-02**	**5.57E+08**	**2.00E-11**	**1.11E-02**	**0.73%**
U-236	2.34E+07	5.51E-03	5.51E-03	2.04E+08	4.70E-12	9.57E-04	0.06%
U-238	**4.47E+09**	**2.39E-03**	**2.39E-03**	**8.86E+07**	**1.70E-10**	**1.51E-02**	**0.99%**
Zr-95	1.75E-01	9.85E+00	0.00E+00	0.00E+00	8.80E-19	0.00E+00	0.00%

4. MODELING APPROACH AND ASSUMPTIONS

For this streamlined risk assessment, two cases are evaluated, a base case, which assumes that the basins are simply filled with soils, and a grouted source scenario. In each case, the sludge and debris are assumed to remain in the CPP-603A basins. The two cases evaluated represent worst-case scenarios with respect to inventory in the pools. Any source removal prior to closure would decrease the predicted risk.

The basic conceptual model and associated parameters chosen for the CPP-603A model are consistent with the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003). A unit mass or activity of each contaminant is used to calculate the resulting concentration at a receptor location. This concentration is then compared with a limiting concentration calculated based on a cancer risk of 10^{-4} or 10^{-6} or a hazard index equal to one. Using this information, an ARC inventory for each contaminant is calculated and compared with the projected inventory in the CPP-603A facility.

The following assumptions were made for the analysis:

- The groundwater pathway is assumed to be the only significant contaminant exposure pathway.
- This evaluation assumes that the current estimated inventory in the CPP-603A facility would be left in place.
- Contaminant diffusion will be negligible from the soil or the grout used to stabilize the source.
- The sludge left in the basins after deactivation, decontamination, and decommissioning is about half the total inventory used for this streamlined risk assessment. Debris and the uncertainty in the sludge inventory is assumed to make up the other half.
- The source thickness is 0.6 m (2 ft), which is the estimated thickness of the contaminated sludge that will be either mixed with soil (base case) or grout (grouted source case) during decontamination and grouting. Either clean soil or grout will be located above the contaminated portion of the grout to isolate the contaminated grout from the ground surface.
- Water and contaminants move straight down through the vadose zone sediments. The contaminant velocity through the sediments depends on the contaminant specific sediment Kd. There is no retardation effect from the basalt and there is no horizontal spreading in the vadose zone. Based on the results of the calibration to the remedial investigation/baseline risk assessment (RI/BRA) model (DOE-ID 1997), the absence of lateral spreading is a conservative assumption.
- The contaminant solubility is conservatively assumed to be infinite for these analyses. If a contaminant appears to pose a significant risk to the groundwater quality, then a reasonable solubility limit could be identified and later incorporated into the analysis.
- ARC inventories for radionuclides are calculated based on limiting aquifer concentrations corresponding to a 10^{-4} and 10^{-6} risk.
- ARC inventories for nonradionuclides are calculated based on limiting aquifer concentrations corresponding to a hazard index of one, a risk of 10^{-6}, or a maximum contaminant level (MCL).
- The receptor is assumed to be 100-m downgradient from the edge of the CPP-603A facility.

- The ARC inventories are based on a predicted peak aquifer concentration regardless of the time of peak. In some cases, the ARC inventory would be much lower if the timeframe of interest was reduced to 1,000 or 10,000 years.

- The ARC inventory for Am-241 is the activity equivalent of the ARC inventory calculated for the Np-237. This assumption was made because the Am-241 decays relatively quickly to Np-237 and the Am-241 is basically immobile in comparison with Np-237. Therefore this conservative assumption is equivalent to assuming that the Am-241 decays immediately to Np-237.

- The ARC inventory for Pu-238 is the activity equivalent of the ARC inventory calculated for the U-234. This assumption was made because the Pu-238 decays relatively quickly to U-234 and the Pu-238 is basically immobile in comparison with U-234. Therefore this conservative assumption is equivalent to assuming that the Pu-238 decays immediately to U-234.

- The *GWSCREEN: A Semi-Analytical Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination: Version 2.0 Theory and User's Manual* (Rood 1999) is used for the source release and contaminant transport simulations.

As discussed above, there are two risk assessment cases evaluated. The following are assumptions that vary based on whether or not the CPP-603A basins will be filled with soils or grout.

- If the basins are filled with soils, water is assumed to move through the contaminated soils at a background infiltration rate of 1 cm/yr. If an infiltration reducing cover such as the proposed ICDF cover is place over CPP-603A, this infiltration rate will be reduced as will the predicted risk.

- If the basins are filled with grouted, the contaminants will be immobilize for 500 years. At 500 years, the grouted basins will instantaneously fail and water will be able to move through the basins.

- After failure of the grouted source, water will move through the grout at a rate of 1 cm/yr, which is equal to the estimated infiltration rate through undisturbed soil at the INEEL. This assumption corresponds to a soil cover that reduces infiltration to the background rates.

Since the two risk assessment scenarios evaluated include one where the contaminants are available to be leached from the basins immediately after closure if the basins are filled with soils and after 500 years if the basins are filled with grout, all nuclide results are compared to both current inventories and inventories with 500 years of radioactive decay.

The conceptual model used for the analysis is shown in Figure 4-1. The parameter values used in the GWSCREEN simulations that are not contaminant specific are shown in Table 4-1. The contaminant specific parameter values are shown in Tables 4-2 for the nonradionuclides and Table 4-3 for the radionuclides.

Listed below are the major contaminant-specific assumptions:

- The contaminant specific partition coefficient (Kd) values are consistent with those used in the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003), which are based primarily on Track 2 default values (DOE-ID 1994), and those used in the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997). In general, these are conservative screening-level values, where:

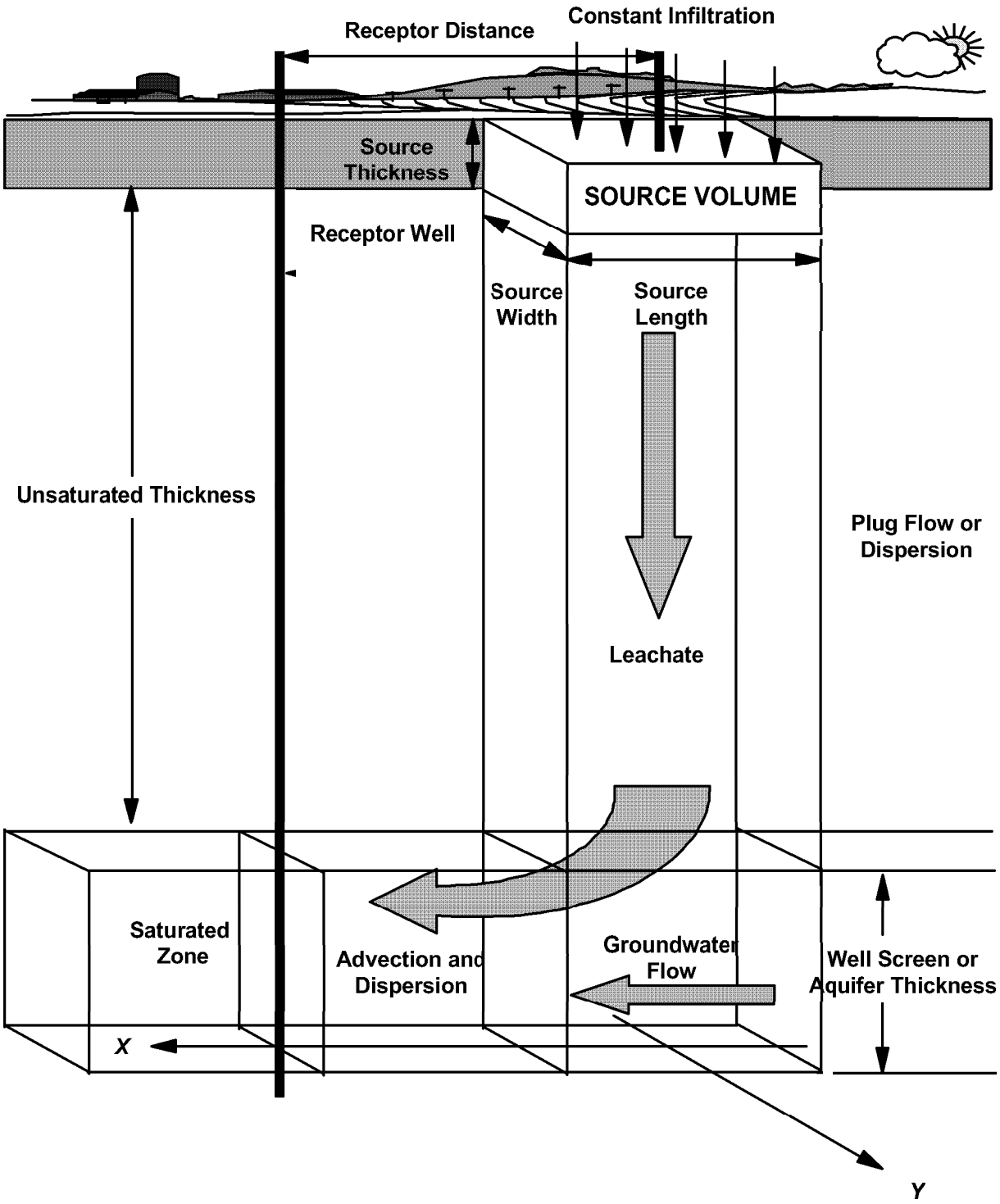

Figure 4-1. Conceptual model of GWSCREEN for the source volume, unsaturated zone, and aquifer (Rood 1999).

Table 4-1. Constant parameter values used in the CPP-603A GWSCREEN simulations.

Parameter	Values	Values	Source of Parameter Values
Source			
Length (CPP-603)	42.9 m	140.7 ft	CPP-603A design (EDF-3684)
Width (CPP-603)	21.4 m	70.2 ft	CPP-603A design (EDF-3684)
Thickness (CPP-603)	0.6 m	2 ft	CPP-603A design (EDF-3684)
Bulk Density	1.5 g/cm^3		ICDF-CA (DOE-ID 2003)
Moisture content	0.3		RI/BRA (DOE-ID 1997)
Infiltration Rate			
0-500 years	0 m/y	0 in/y	ICDF-CA (DOE-ID 2003)
500 years and after	0.01 m/y	0.4 in/y	ICDF-CA (DOE-ID 2003)
Unsaturated Zone			
Thickness (cumulative interbeds)	22.7 m	74.5 ft	ICDF-CA (DOE-ID 2003)
Longitudinal dispersivity	2.92 m	9.6 ft	ICDF-CA (DOE-ID 2003)
Bulk Density	1.36 g/cm^3		ICDF-CA (DOE-ID 2003)
Moisture content [a]	0.285		Calculated in GWSCREEN
Aquifer			
Thickness	76 m	250 ft	ICDF-CA (DOE-ID 2003)
Well Screen Thickness	15 m	49.2 ft	Track 2 Guidance Document (DOE 1994)
Darcy Velocity	21.9 m/y	71.85 ft/y	ICDF-CA (DOE-ID 2003)
Average Linear Velocity	365 m/y	1200 ft/y	Calculated
Porosity	0.06		ICDF-CA (DOE-ID 2003)
Bulk Density	2.49 g/cm^3		ICDF-CA (DOE-ID 2003)
Variable Longitudinal Dispersivity[b]	4.9 m	16 ft	Calculated in GWSCREEN at 100 m from CPP-603
Ratio Transverse / Longitudinal	0.2		ICDF-CA (DOE-ID 2003)
Ratio Vertical / Longitudinal	0.00116		ICDF-CA (DOE-ID 2003)
Receptor Distance from the Center of the Source			
x (along flow direction)	121.45 m	398 ft	100 m downgradient of CPP-603
y (perpendicular to flow direction)	0 m	0 ft	Along the line of maximum concentration
Receptor Scenario			
Drinking water ingestion rate	2 L/day		
Exposure frequency	350 d/yr		
Exposure duration	30 yr		
Averaging time	70y=25,550d		

a. characteristic curve in the vadose zone uses the van Genuchten formulation to calculate the moisture content (Rood 1999). The parameter values used are:

- residual moisture content = 0.142
- saturated moisture content = 0.487
- saturated hydraulic conductivity (m/y) = 21.13
- a fitting parameter (1/m) = 1.066
- n fitting parameter = 1.523

b. longitudinal dispersivity is defined as $1.20(\log_{10} L)^{2.958}$ where L=121.45m (Rood 1999, Section 2.3)
CPP = Chemical Processing Plant
EDF = engineering design file
RI/BRA = remedial investigation/baseline risk assessment

Table 4-2. Nonradionuclide contaminant-specific parameter values used in the CPP-603A analysis.

COPCs	Reference Dose or Slope Factor	Hazard or Risk Based Limiting Concentration[c]	CPP-603A Inventory[a]	Soil-Water Partition Coefficient		
				Soil	Aquifer Basalt	Concrete
	RFD (mg/kg/d) or SF (mg/kg/d)$^{-1}$	(mg/L)	(mg)	(mL/g)	(mL/g)	(mL/g)
Acetone	1.00E-01	3.56E+00	3.0E+05	0	0	0[d]
Benzene	2.90E-2(SF)	2.93E-03	1.1E+04	0.2	0.008	0.2[d]
Bromomethane	1.40E-03	5.11E-02	2.1E+03	NA	NA	NA
2-Butanone	6.00E-01	2.19E+01	3.6E+03	NA	NA	NA
1,1-Dichloroethene	NA	7E-03(MCL)	3.3E+03	0.19	0.0076	0.19[d]
Methylene Chloride	7.50E-3(SF)	1.13E-02	3.3E+03	0.026	0.00104	0.026[d]
4-Methyl-2-pentanone	NA	NA	3.5E+03	NA	NA	NA
Toluene	2.00E-01	7.30E+00	6.0E+03	1	0.04	1[d]
m- and p-Xylene	2.00E+00	7.30E+01	7.2E+03	3	0.12	3[d]
O-Xylene	2.00E+00	7.30E+01	3.4E+03	NA	NA	NA
Styrene	2.00E-01	7.30E+00	3.8E+03	NA	NA	NA
Aluminum	1.00E+00	3.65E+01	3.9E+09	250	10	250[d]
Arsenic	1.50E+0(SF)	5.67E-05	1.8E+06	3	0.12	3[d]
Barium	7.00E-02	2.56E+00	1.9E+07	50	2	50[d]
Beryllium	4.30E+0(SF)	1.98E-05	3.8E+04	250	10.	250[d]
Cadmium	1.00E-03	3.65E-02	2.3E+07	6	0.24	23[b]
Chloride	NA	2.5E+2(MCL)	7.9E+07	0	0	1[c]
Chromium	5.00E-03	1.83E-01	7.2E+07	1.2	0.048	1.2[d]
Lead	NA	1.5E-2(MCL)	9.5E+07	100	4	100[d]
Mercury	1.00E-04	3.65E-03	5.3E+01	100	4	60[b]
Nickel	2.00E-02	7.30E-01	1.5E+06	100	4	100[c]
Selenium	5.00E-03	1.83E-01	6.0E+05	4	0.16	4[d]
Silver	5.00E-03	1.83E-01	3.9E+04	90	3.6	90[d]
Uranium	3.00E-03	1.10E-01	1.4E+07	6	0.24	2000[b]
Zinc	3.00E-01	1.10E+01	1.4E+09	16	0.64	16[d]

a. From Demmer, R., 1996a, "Basin Sludge Calculations for CPP-603 Fuel Basins", RLD-08-96, letter report to Thorton Waite from Rick Demmer, Dated Aug. 20, 1996.
b. From the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003).
c. From the *Effects of Radionuclide Concentrations by Cement/Ground-water Interactions in Support of Performance Assessment of Low-Level Radioactive Waste Disposal Facilities* (Krupka and Serne, 1998), Table 5-1.
d. No concrete Kd information available. The soils Kd value was used.
e. The hazard and risk based limiting concentrations are calculated based on the reference dose or slope factor and exposure parameters. The exposure parameters are listed in Table 4-1.

CFR = *Code of Federal Regulations*
COPC = contaminant of potential concern
CPP = Chemical Processing Plant
INEEL = Idaho National Engineering and Environmental Laboratory
MCL = maximum contaminant level—maximum drinking water concentration limit is based on 40 CFR 141.61, "Maximum Contaminant Levels for Organic Contaminants."
NA = not available—assume Kd = 0 for the soil and aquifer basalt.
OU = operable unit
RI/BRA = remedial investigation/baseline risk assessment
RI/FS = remedial investigation/feasibility study
SF = Limiting concentration is based on a slope factor. The others are based on a reference dose. The slope factors are taken from the tables in the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997) to be consistent with the OU 3-13 Comprehensive RI/BRA.

Table 4-3. Radionuclide contaminant-specific-parameter values used in the GWSCREEN Analysis.

COPCs Parent	Progeny	Radioactive Half-Life (yr)	Slope Factor[b] (1/pCi)	10^{-6} Risk Based Water Conc[c] (pCi/L)	CPP-603A Inventory Current Estimate (Ci)	CPP-603A Inventory Estimate After 500 Years of Decay (Ci)	Soil-Water Partition Coefficient (Kd)[a] Soil (mL/g)	Aquifer (mL/g)	Concrete (mL/g)
Am-241		432	3.28E-10	1.46E-01	4.50E-02	2.02E-02	340	13.6	5000
	Np-237	2.14E+06	3.00E-10	1.60E-01			8	0.32	
	U-233	1.59E+05	4.48E-11	1.07E+00			6	0.24	
	Th-229	7340	3.56E-10	1.35E-01			100	4	
C-14		5.73E+03	1.03E-12	4.62E+01	6.26E-04	5.88E-04	0.1	0.004	10
I-129		1.57E+07	1.84E-10	2.59E-01	1.55E-05	1.55E-05	0.1	0.004	2
Np-237		2.14E+06	3.00E-10	1.60E-01	1.00E-02	1.00E-02	8	0.32	5000
	U-233	1.59E+05	4.48E-11	1.07E+00			6	0.24	
	Th-229	7340	3.56E-10	1.35E-01			100	4	
Pu-238		87.8	2.95E-10	1.63E-01	5.52E-01	1.06E-02	140	5.6	5000
	U-234	2.45E+05	4.44E-11	1.08E+00			6	0.24	
	Th-230	7.54E+04	3.75E-11	1.28E+00			100	4	
	Ra-226	1600	2.96E-10	1.62E-01			100	4	
	Pb-210	22.3	1.01E-09	4.75E-02			100	4	
Pu-239		2.41E+04	3.16E-10	1.52E-01	4.02E+00	3.96E+00	140	5.6	5000
	U-235	7.04E+08	4.70E-11	1.02E+00			6	0.24	
	Pa-231	3.28E+04	1.49E-10	3.19E-01			550	22	
	Ac-227	21.8	6.26E-10	7.60E-02			450	18	
Pu-240		6.56E+03	3.15E-10	1.51E-01	4.02E+00	3.96E+00	140	5.6	5000
	U-236	2.34E+07	4.21E-11	1.13E+00			6	0.24	
	Th-232	1.41E+10	3.28E-11	1.45E+00			100	4	
	Ra-228	5.75	2.48E-10	1.92E-01			100	4	
	Pb-210	1.91	2.31E-10	2.06E-01			100	4	
Tc-99		2.11E+05	1.40E-12	3.40E+01	1.25E-03	1.25E-03	0.2	0.008	1000
U-234		2.45E+05	4.44E-11	1.08E+00	6.96E-01	6.96E-01	6	0.24	2000
	Th-230	7.54E+04	3.75E-11	1.28E+00			100	4	
	Ra-226	1600	2.96E-10	1.62E-01			100	4	
	Pb-210	22.3	1.01E-09	4.75E-02			100	4	
U-235		7.04E+08	4.70E-11	1.02E+00	3.02E-02	3.02E-02	6	0.24	2000
	Pa-231	3.28E+04	1.49E-10	3.19E-01			550	22	
	Ac-227	21.8	6.26E-10	7.60E-02			450	18	
U-238		4.47E+09	6.20E-11	7.68E-01	4.78E-03	4.78E-03	6	0.24	2000
	U-234	2.45E+05	4.44E-11	1.08E+00			6	0.24	
	Th-230	7.54E+04	3.75E-11	1.28E+00			100	4	
	Ra-226	1600	2.96E-10	1.62E-01			100	4	
	Pb-210	22.3	1.01E-09	4.75E-02			100	4	

Note – progeny ingrowth was ignored for the first 500 years.

a. From the *Composite Analysis for the INEEL CERLCA Disposal Facility Landfill* (DOE-ID 2003)

b. Slope factors were taken from the tables in the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997) to be consistent with the OU 3-13 Comprehensive RI/BRA. They are based on FGR-13.

c. The risk-based concentrations are calculated based on the slope factor and exposure parameters. (Table 4-1)

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
COPC = contaminant of potential concern
CPP = Chemical Processing Plant
INEEL = Idaho National Engineering and Environmental Laboratory
OU = operable unit
RI/BRA = remedial investigation/baseline risk assessment
RI/FS = remedial investigation/feasibility study

- For chemicals where no Kd could be found, a conservative value of 0 mL/g was assumed.

- For chemicals for which no concrete Kd values are available, soil Kd values were used. This assumes there is no grouting but the CPP-603A pools are simply filled with soil.

- In the vadose zone sediments, Kd values are taken from the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003) modeling.

- In the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997), it was assumed that the aquifer basalt Kd values are 25 times smaller than the assumed soil Kd values. The same assumption was used in the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003) and this evaluation.

- Radionuclide progeny were included in the analysis. The progeny are assumed to move with the parent in the GWSCREEN simulations.

5. CPP-603A RESULTS

In Tables 5-1, 5-2, and 5-3 are the model predictions, calculated ARC inventories, and comparison with the current estimated inventory and the nuclide inventory projected after 500 years of radioactive decay. Table 5-1 shows the nonradionuclide results and Tables 5-2 and 5-3 show the radionuclide results assuming a soil source in Table 5-2 and grouted source in Table 5-3. As discussed above, for both the nonradionuclides and the radionuclides, a baseline calculation was done making the assumption that the basins are filled with soil (rather than grout) and the ARC inventory is calculated for the CPP-603A basins. In the case of the nonradionuclides, the analysis shows that there are no contaminants that are predicted to be transported into the aquifer and result in aquifer concentrations above the MCL or a 10^{-6} risk based concentration (Table 5-1). Therefore, based on the nonradionuclide analysis, there is no need to grout the CPP-603A basins. For the radionuclides, when soils are used to fill the basins (Table 5-2), the analysis predicts that U-234 will be transported to the aquifer and result in aquifer concentrations that are approximately twice the 10^{-6} risk based U-234 concentration. Therefore, the radionuclides are reevaluated using source term Kd values that are appropriate for a grouted source (Table 5-3). Assuming a grouted source, the predicted U-234 aquifer concentration is a factor of 5 below the 10^{-6} risk based U-234 concentration.

Am-241 and Pu-238 are nuclides that are strongly sorbed but decay relatively quickly to more mobile contaminants (Np-237 and U-234). Therefore, exposure and risk in the aquifer from Am-241 and Pu-238 would come from the progeny Np-237 and U-234. In Tables 5-2 and 5-3, the Am-241 and Pu-238 ARC inventories are the activity equivalent of the ARC inventories calculated for the Np-237 and the U-234, respectfully. In addition, in the CPP-603A inventory columns, Np-237 and U-234 inventories are listed under the Am-241 and Pu-238 inventories because the Am-241 and Pu-238 inventories after 500 years are misleading with respect to the model assumptions and results. Since the Am-241 and Pu-238 are assumed to exist completely as Np-237 and U-234, there are essentially no differences between the current inventory and the inventory in 500 years.

C-14, I-129, and Tc-99 inventories were based solely on water samples and are not conservative if there is inventory adsorbed to the sludge or in the debris or discrete objects. As can be seen in Table 5-2 and 5-3, the estimated inventories are a factor of 350 less than the ARC inventory and 1000s of time less than the C-14 and Tc-99 inventory. Even if the C-14, I-129, and Tc-99 are somewhat underestimated, the inventories are still well below the ARC inventories.

Based on this streamlined risk assessment, grouting of the basins and canals while leaving all current source inventory in place results in predicted groundwater concentrations that meet the required performance criteria. For groundwater, the performance criteria is to prevent migration of contaminants from the CPP-603A basins that would cause the Snake River Plain Aquifer, located outside the INTEC security fence, to exceed a cumulative carcinogenic risk level of 1×10^{-4}, a total hazard index of one, or applicable State of Idaho groundwater quality standards in 2095 and beyond.

Table 5-1. Nonradionuclide ARC inventories and comparison with projected residual inventory assuming a soil source term.

	10^{-6} Risk Based Limiting Concentration (mg/m^3)	MCL (mg/m^3)	Predicted Time of Peak Concentration (years)	Predicted Peak Concentration From Unit Inventory (mg/m^3)	**ARC Inventory Based on** Limiting Concentration (mg)	**ARC Inventory Based on** MCL (mg)	Estimated CPP-603A Inventory (Table 2-2) (mg)
Acetone	3.56E+03	NA	5.13E+02	7.05E-08	5.05E+10	NA	3.00E+05
Benzene	2.93E+00	5.00E+00	1.00E+03	3.61E-08	8.12E+07	1.39E+08	1.10E+04
Bromomethane	5.11E+01	NA	5.13E+02	7.05E-08	7.25E+08	NA	2.10E+03
2-Butanone	2.19E+04	NA	5.13E+02	7.05E-08	3.11E+11	NA	3.60E+03
1,1-Dichloroethene	7.00E+00	7.00E+00	9.78E+02	3.70E-08	1.89E+08	1.89E+08	3.30E+03
Methylene Chloride	1.13E+01	NA	5.76E+02	6.27E-08	1.80E+08	NA	3.30E+03
4-Methyl-2-pentanone	NA	NA	5.13E+02	7.05E-08	NA	NA	3.50E+03
Toluene	7.30E+03	1.00E+04	2.96E+03	1.22E-08	5.97E+11	8.18E+11	6.00E+03
m- and p-Xylene	7.30E+04	1.00E+04	7.86E+03	4.61E-09	1.59E+13	2.17E+12	7.20E+03
O-Xylene	7.30E+04	1.00E+02	5.13E+02	7.05E-08	1.04E+12	1.42E+09	3.40E+03
Styrene	7.30E+03	1.00E+03	5.13E+02	7.05E-08	1.04E+11	1.42E+10	3.80E+03
Aluminum	3.65E+04	2.00E+02	6.13E+05	5.91E-11	6.18E+14	3.39E+12	3.90E+09
Arsenic	5.67E-02	5.00E+01	7.86E+03	4.61E-09	1.23E+07	1.09E+10	1.80E+06
Barium	2.56E+03	2.00E+03	1.23E+05	2.94E-10	8.70E+12	6.79E+12	1.90E+07
Beryllium	1.98E-02	4.00E+00	6.13E+05	5.91E-11	3.35E+08	6.77E+10	3.80E+04
Cadmium	3.65E+01	5.00E+00	1.52E+04	2.38E-09	1.53E+10	2.10E+09	2.30E+07
Chloride	2.50E+05	2.50E+05	5.13E+02	7.05E-08	3.55E+12	3.55E+12	7.90E+07
Chromium	1.83E+02	1.00E+02	3.45E+03	1.05E-08	1.75E+10	9.54E+09	7.20E+07
Lead	1.50E+01	1.50E+01	2.45E+05	1.48E-10	1.02E+11	1.02E+11	9.50E+07
Mercury	3.65E+00	2.00E+00	2.45E+05	1.48E-10	2.47E+10	1.36E+10	5.30E+01
Nickel	7.30E+02	1.00E+02	2.45E+05	1.48E-10	4.95E+12	6.78E+11	1.50E+06
Selenium	1.83E+02	5.00E+01	1.03E+04	3.51E-09	5.21E+10	1.42E+10	6.00E+05
Silver	1.83E+02	1.00E+02	2.21E+05	1.64E-10	1.12E+12	6.10E+11	3.90E+04
Uranium	1.10E+02	3.00E+01	1.52E+04	2.38E-09	4.62E+10	1.26E+10	1.40E+07
Zinc	1.10E+04	5.00E+03	3.97E+04	9.12E-10	1.21E+13	5.48E+12	1.40E+09

MCL = maximum contaminant level
NA = not available

Table 5-2. Radionuclide ARC inventories assuming a soil source (baseline) and comparison with projected residual inventory.

		Predicted From Unit Inventory		Risk Based ARC inventory		CPP-603A Inventory	
	10^{-6} Risk Based Water Conc. (pCi/L)	Time of Peak Conc. (Years)	Peak Conc. (pCi/L)	10^{-6} Risk (Ci)	10^{-4} Risk (Ci)	Current Estimate[a] (Ci)	Projected in 500 Years (Ci)
Am-241[b]	1.46E-01	2.01E+04	—	4.30E+02	4.30E+04	4.50E-02	2.02E-02
as Np-237	1.60E-01	Am-241 assumed to be all Np-237		8.69E-02	8.69E+00	9.24E-06	9.24E-06
U-233	1.07E+00						
Th-229	1.35E-01						
C-14	4.62E+01	7.41E+02	4.36E+01	1.06E+00	1.06E+02	6.26E-04	5.88E-04
I-129[c]	2.59E-01	7.58E+02	4.77E+01	5.42E-03	5.42E-01	1.55E-05	1.55E-05
Np-237	1.60E-01	2.01E+04	1.79E+00	8.69E-02	8.69E+00	1.00E-02	1.00E-02
U-233	1.07E+00		1.96E-01				
Th-229	1.35E-01		7.17E-03				
Pu-238[b]	1.63E-01	1.50E+04	—	1.07E+03	1.07E+05	5.52E-01	1.06E-02
U-234	1.08E+00	Pu-238 assumed to be all U-234		3.84E-01	3.84E+01	2.02E-04	2.02E-04
Th-230	1.28E+00						
Ra-226	1.62E-01						
Pb-210	4.75E-02						
Pu-239	1.52E-01	1.51E+05	2.71E-04	5.50E+02	5.50E+04	4.02E+00	3.96E+00
U-235	1.02E+00		1.51E-05				
Pa-231	3.19E-01		1.61E-07				
Ac-227	7.60E-02		1.97E-07				
Pu-240	1.51E-01	8.70E+04	5.58E-08	3.06E+05	3.06E+07	4.02E+00	3.96E+00
U-236	1.13E+00		3.28E-06				
Th-232	1.45E+00		8.21E-13				
Ra-228	1.92E-01		8.21E-13				
Th-228	2.06E-01		8.21E-13				
Tc-99	3.40E+01	1.00E+03	3.60E+01	9.46E-01	9.46E+01	1.25E-03	1.25E-03
U-234	1.08E+00	1.50E+04	2.28E+00	3.84E-01	3.84E+01	6.96E-01	6.96E-01
Th-230	1.28E+00		1.97E-02				
Ra-226	1.62E-01		1.69E-02				
Pb-210	4.75E-02		1.69E-02				
U-235	1.02E+00	1.52E+04	2.38E+00	4.00E-01	4.00E+01	3.02E-02	3.02E-02
Pa-231	3.19E-01		7.84E-03				
Ac-227	7.60E-02		9.57E-03				
U-238	7.68E-01	1.52E+04	2.38E+00	3.12E-01	3.12E+01	4.78E-03	4.78E-03
U-234	1.08E+00		1.00E-01				
Th-230	1.28E+00		4.42E-04				
Ra-226	1.62E-01		3.30E-04				
Pb-210	4.75E-02		3.29E-04				

a. The ARC inventory is based on the total risk including progeny. The risk for each of the progeny is not shown in this table but is calculated in GWSCREEN and incorporated into the calculation of the ARC inventory.

b. Am-241 is evaluated as Np-237 and Pu-238 is evaluated as U-234.

c. Based on an I-129 MCL of 1 pCi/L, the ARC inventory would be 0.02 Ci.

ARC = allowable residual contamination
CPP = Chemical Processing Plant (now known as INTEC)
MCL = maximum contaminant level

Table 5-3. Radionuclide ARC inventories assuming a grouted source and comparison with projected residual inventory.

		Predicted From Unit Inventory		Risk Based ARC inventory		CPP-603A Inventory	
	10^{-6} Risk Based Water Conc. (pCi/L)	Time of Peak Conc. (Years)	Peak Conc. (pCi/L)	10^{-6} Risk (Ci)	10^{-4} Risk (Ci)	Current Estimate[a] (Ci)	Projected in 500 Years (Ci)
Am-241[b]	1.46E-01	6.40E+04	—	7.45E+03	7.45E+05	4.50E-02	2.02E-02
as Np-237	1.60E-01	Am-241 assumed to be all Np-237		1.50E+00	1.50E+02	9.24E-06	9.24E-06
U-233	1.07E+00						
Th-229	1.35E-01						
C-14	4.62E+01	1.27E+03	2.10E+01	2.21E+00	2.21E+02	6.26E-04	5.88E-04
I-129[c]	2.59E-01	9.45E+02	4.22E+01	6.13E-03	6.13E-01	1.55E-05	1.55E-05
Np-237	1.60E-01	6.40E+04	9.88E-02	1.50E+00	1.50E+02	1.00E-02	1.00E-02
U-233	1.07E+00		3.16E-02				
Th-229	1.35E-01		1.77E-03				
Pu-238[b]	1.63E-01	4.00E+04	—	8.85E+03	8.85E+05	5.52E-01	1.06E-02
as U-234	1.08E+00	Pu-238 assumed to be all U-234		3.17E+00	3.17E+02	2.02E-04	2.02E-04
Th-230	1.28E+00						
Ra-226	1.62E-01						
Pb-210	4.75E-02						
Pu-239	1.52E-01	1.71E+05	2.26E-05	6.57E+03	6.57E+05	4.02E+00	3.96E+00
U-235	1.02E+00		2.21E-06				
Pa-231	3.19E-01		2.45E-08				
Ac-227	7.60E-02		3.00E-08				
Pu-240	1.51E-01	9.04E+04	2.52E-09	4.93E+06	4.93E+08	4.02E+00	3.96E+00
U-236	1.13E+00		2.11E-07				
Th-232	1.45E+00		5.51E-14				
Ra-228	1.92E-01		5.51E-14				
Th-228	2.06E-01		5.51E-14				
Tc-99	3.40E+01	3.96E+03	5.36E-01	6.35E+01	6.35E+03	1.25E-03	1.25E-03
U-234	1.08E+00	4.00E+04	2.09E-01	3.17E+00	3.17E+02	6.96E-01	6.96E-01
Th-230	1.28E+00		4.46E-03				
Ra-226	1.62E-01		4.26E-03				
Pb-210	4.75E-02		4.26E-03				
U-235	1.02E+00	4.41E+04	2.36E-01	3.77E+00	3.77E+02	3.02E-02	3.02E-02
Pa-231	3.19E-01		1.71E-03				
Ac-227	7.60E-02		2.09E-03				
U-238	7.68E-01	4.41E+04	2.36E-01	2.93E+00	2.93E+02	4.78E-03	4.78E-03
U-234	1.08E+00		2.76E-02				
Th-230	1.28E+00		3.29E-04				
Ra-226	1.62E-01		2.99E-04				
Pb-210	4.75E-02		2.98E-04				

a. The ARC inventory is based on the total risk including progeny. The risk for each of the progeny is not shown in this table but is calculated in GWSCREEN and incorporated into the calculation of the ARC inventory.
b. Am-241 is evaluated as Np-237 and Pu-238 is evaluated as U-234.
c. Based on an I-129 MCL of 1 pCi/L, the ARC inventory would be 0.02 Ci.
ARC = allowable residual contamination
CPP = Chemical Processing Plant (now known as INTEC)
MCL = maximum contaminant level

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Appendix A

GWSCREEN Model Results

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Appendix A

GWSCREEN Model Results

GWSCREEN Input Deck – Non-Radionuclides Set #1

```
Organics - CPP-603 - based on assumptions of ICDF CA modeling
4 3 1 1 1                                    (Card 2) imode,itype,idisp,kflag,idil
1 1 2 1 2                                 (Card 3) imodel,isolve,isolveu,imoist,imoistu
6 15 0.01                                    (Card 4) jstart jmax eps
70. 2.555E+04 2.0 350.  30.  1.0             (Card 5) bw,at,wi,ef,ed,dlim
0.   0.                                          (Card 6) x0,y0
42.9  21.4  0.010                                (Card 7) l,w,perc
0.6  1.5                                  (Card 8b) thicks, rhos, (source term values)
0.30                                         (Card 8c) thetas (source term mc)
22.7   1.359  2.92                             (Card 9) depth,rhou,axu
$ NOTE: The values of depth and axu are the ucode calibrated values
$ van Genuchten parameters from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
1.066 1.523  21.13 0.487 0.142                (Card 9b) alphau nu ksatu porsu thetaru
$use calib values for ax and az ay=0.2ax and az=1.16e-3ax as stated in the MEPAS Manual
3.31 0.2  1.163E-3   76.  15.             (Card 10) ax,ay,az,b,z(well screen thickness)
$ Aqui dens and porosity from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
$ --- Darcy velocity based on an assumed pore vel of ~ 1 m/d in EDF-ER-275
21.9  0.06  2.491                              (Card 11) u,phi,rhoa
1                                                (Card 12a) nrecept
121.45   0.                                  (Card 12b x y)
11                                               (Card 14) ncontam
$  ------------------------- Acetone ------------------ 1
0 0. 0.  999 1.0   1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"ace" 1.e12 0.  3.56e3                  (card14b) cname thalf kda dcf
$  ------------------------- Benzene ------------------ 2
0 0.2 0.2  999 1.0   1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"benz" 1.e12 0.008  2.93                (card14b) cname thalf kda dcf
$  ------------------------- Bromomethane------------------ 3
0 0. 0.  999 1.0   1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"bro"  1.e12 0.  51.1                   (card14b) cname thalf kda dcf
$  ------------------------- 2-Butanone------------------ 4
0 0.0 0.0  999 1.0   1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"2-but" 1.e12 0.  2.19E+04                (card14b) cname thalf kda dcf
$  ------------------------- 1,1-dichloroethene ------------------ 5
0 0.19 0.19 999 1.0  1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"dichl" 1.e12 0.0076     7.             (card14b) cname thalf kda dcf
$  ------------------------- Methylene chloride------------------ 6
0 0.026 0.026 999 1.0  1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"meth" 1.e12 0.00104  11.3           (card14b) cname thalf kda dcf
$  ------------------------- 4-methyl-2-pentanone------------------ 7
0 0.0 0.0 999 1.0   1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"4-meth" 1.e12 0.  0.9999                 (card14b) cname thalf kda dcf
$  ------------------------- toluene------------------ 8
0 1.0 1.0  999 1.0  1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"tol" 1.e12 0.04  7300.                 (card14b) cname thalf kda dcf
$  ------------------------- m- and p-xylene ------------------ 9
0 3.0 3.0  999 1.0   1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"mp-xyl" 1.e12 0.12  73000.             (card14b) cname thalf kda dcf
$  ------------------------- o-xylene  ------------------ 10
0 0. 0.  999 1.0   1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"o-xyl" 1.e12 0.  73000.                (card14b) cname thalf kda dcf
$  ------------------------- Styrene------------------ 11
0 0. 0. 999 1.0  1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
"styr" 1.e12 0.  7300.                  (card14b) cname thalf kda dcf
```

GWSCREEN Output – Non-Radionuclides Set #1

```
*************************************************
*                                               *
*     This output was produced by the model:    *
*                                               *
*                   GWSCREEN                    *
*                 Version 2.5a                  *
*    A semi-analytical model for the assessment *
*    of the groundwater pathway from the leaching *
*    of surficial and buried contamination and  *
*  release of contaminants from percolation ponds *
*                  08/26/2003                   *
*                Arthur S. Rood                 *
*         Idaho National Engineering and        *
*            Environmental Laboratory           *
*                  PO Box 1625                  *
*             Idaho Falls, Idaho 83415          *
*************************************************
```

ACKNOWLEDGEMENT OF GOVERNMENT SPONSORSHIP AND LIMITATION OF LIABILITY


```
 OUTPUT FILE NAME: u-soil-nrad1.out
 INPUT FILE NAME: u-soil-nrad1.par
Title: Organics - CPP-603 - based on assumptions of ICDF CA modeling
-----------------------------------------------------------------------------
Model Run Options
-----------------------------------------------------------------------------
IMODE Contaminant Type and Impacts:                              4
ITYPE (1) Vert Avg (2) 3D Point (3) 3d Avg:                      3
IDISP (0) Fixed Dispersivity (1-3) Spatially Varying:            1
KFLAG (1) Max Conc (2) Conc vs Time (3) Grid Output:             1
IDIL (1) No dilution factor (2) Include Dilution Factor:         1
IMOIST Source Moisture Content Option:                           1
IMOISTU Unsaturated Moisture Content Option:                     2
IMODEL (1) Surface/Burried Src (2) Pond (3) Usr Def:             1
ISOLVE (1) Gaussian Quarature (2) Simpsons Rule: (Aquifer)       1
ISOLVEU (1) Gaussian Quarature (2) Simpsons Rule: (Unsat Zone)   2
JSTART:   6
JMAX   :  15
EPS    :  1.000E-02
Health Effects: Ratio of groundwater concentration to MCL
Output mass/activity units:    mg
Output concentration units:    mg/m**3
Dose/Risk Conversion Units:    mg/m**3
Output health effects units:   Ratio of Cp/Cmcl
Cp = Peak groundwater concentration, Cmcl = Maximum contaminant limit
-----------------------------------------------------------------------------
Exposure Parameters
-----------------------------------------------------------------------------
Body Mass (kg):              70.       Averaging Time (days):      25550.
Water Ingestion (L/d):       2.000E+00 Exposure Freq (day/year):   3.500E+02
Exposure Duration (y):       3.000E+01 Limiting Dose:              1.000E+00
```

```
------------------------------------------------------------------------------
Site Parameters
------------------------------------------------------------------------------
X Coordinate:                0.000E+00  Y Coordinate:                0.000E+00
Source Length (m):           4.290E+01  Source Width (m):           2.140E+01
Percolation Rate (m/y):      1.000E-02
Source Thickness (m):        6.000E-01  Src Bulk Density (g/cc):    1.500E+00
Source Moisture Content:     3.000E-01
------------------------------------------------------------------------------
Unsaturated Zone Parameters
------------------------------------------------------------------------------
Unsat Zone Thickness (m):    2.270E+01  Unsat Bulk Density:         1.359E+00
Unsat Alpha (1/m):           1.066E+00  Unsat n:                    1.523E+00
Saturated K in Unsat (m/y):  2.113E+01  Porosity of Unsat Zone:     4.870E-01
Unsat Residual Moisture:     1.420E-01  Unsat Dispersivity (m):     2.920E+00
------------------------------------------------------------------------------
Aquifer Zone Parameters
------------------------------------------------------------------------------
Transverse/Longitud Ratio:   2.000E-01  Vertical/Longitud Ratio:    1.163E-03
Aquifer Thickness (m):       7.600E+01  Well Screen Thickness (m):  1.500E+01
Darcy Velocity (m/y):        2.190E+01  Aquifer Porosity:           6.000E-02
Bulk Density (g/cc):         2.491E+00
------------------------------------------------------------------------------
Calculated Flow Parameters
------------------------------------------------------------------------------
Percolation Water Flux (m3/y):  9.1806E+00
Unsaturated Moisture Content:   2.8499E-01
Unsat Pore Velocity (m/y):      3.5089E-02
Aquifer Pore Velocity (m/y):    3.6500E+02
------------------------------------------------------------------------------
Contaminant Data
------------------------------------------------------------------------------
 Contaminant Name:               ace
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               0.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                0.000E+00
 Kd Aquifer (ml/g):              0.000E+00
 Risk/Dose Conversion Factor:    3.560E+03
------------------------------------------------------------------------------
Calculated Contaminant Values
------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3):   6.0514E-03
Solubility Limited Mass (mg):              1.6525E+11
Unsaturated Retardation Factor:            1.0000E+00
Mean Unsaturated Transit Time (y):         5.6903E+02
Leading Edge Arrival Time (y):             4.4500E+01
Aquifer Retardation Factor:                1.000E+00
Minimum Peak Window Time (y):              4.4594E+01
Maximum Peak Window Time (y):              6.9422E+02
------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):              7.051E-08
Time of Peak (y):                          5.1274E+02
Concentrations Averaged Between:       4.9774E+02 and  5.2774E+02 years
Average Concentration (mg/m**3):           7.047E-08
Maximum Dose:                              1.979E-11
Maximum Allowable Inventory (mg):          5.052E+10
------------------------------------------------------------------------------
Contaminant Data
------------------------------------------------------------------------------
 Contaminant Name:               benz
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               2.000E-01
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                2.000E-01
 Kd Aquifer (ml/g):              8.000E-03
 Risk/Dose Conversion Factor:    2.930E+00
------------------------------------------------------------------------------
Calculated Contaminant Values
```

```
-------------------------------------------------------------------------------
Decay Constants (1/y):                    6.9315E-13
Leach Rate Constant (1/y):                2.7778E-02
Initial Pore Water Conc (Ci or mg/m**3):  3.0257E-03
Solubility Limited Mass (mg):             3.3050E+11
Unsaturated Retardation Factor:           1.9537E+00
Mean Unsaturated Transit Time (y):        1.1117E+03
Leading Edge Arrival Time (y):            8.6942E+01
Aquifer Retardation Factor:               1.332E+00
Minimum Peak Window Time (y):             8.7067E+01
Maximum Peak Window Time (y):             1.3618E+03
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):             3.609E-08
Time of Peak (y):                         1.0024E+03
Concentrations Averaged Between:       9.8744E+02 and  1.0174E+03 years
Average Concentration (mg/m**3):          3.608E-08
Maximum Dose:                             1.231E-08
Maximum Allowable Inventory (mg):         8.121E+07
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               bro
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               0.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                0.000E+00
 Kd Aquifer (ml/g):              0.000E+00
 Risk/Dose Conversion Factor:    5.110E+01
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                    6.9315E-13
Leach Rate Constant (1/y):                5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3):  6.0514E-03
Solubility Limited Mass (mg):             1.6525E+11
Unsaturated Retardation Factor:           1.0000E+00
Mean Unsaturated Transit Time (y):        5.6903E+02
Leading Edge Arrival Time (y):            4.4500E+01
Aquifer Retardation Factor:               1.000E+00
Minimum Peak Window Time (y):             4.4594E+01
Maximum Peak Window Time (y):             6.9422E+02
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):             7.051E-08
Time of Peak (y):                         5.1274E+02
Concentrations Averaged Between:       4.9774E+02 and  5.2774E+02 years
Average Concentration (mg/m**3):          7.047E-08
Maximum Dose:                             1.379E-09
Maximum Allowable Inventory (mg):         7.251E+08
```

```
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               2-but
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               0.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                0.000E+00
 Kd Aquifer (ml/g):              0.000E+00
 Risk/Dose Conversion Factor:    2.190E+04
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    6.9315E-13
Leach Rate Constant (1/y):                5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3):  6.0514E-03
Solubility Limited Mass (mg):             1.6525E+11
Unsaturated Retardation Factor:           1.0000E+00
Mean Unsaturated Transit Time (y):        5.6903E+02
Leading Edge Arrival Time (y):            4.4500E+01
Aquifer Retardation Factor:               1.000E+00
Minimum Peak Window Time (y):             4.4594E+01
Maximum Peak Window Time (y):             6.9422E+02
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):             7.051E-08
Time of Peak (y):                         5.1274E+02
Concentrations Averaged Between:       4.9774E+02 and  5.2774E+02 years
Average Concentration (mg/m**3):          7.047E-08
Maximum Dose:                             3.218E-12
Maximum Allowable Inventory (mg):         3.108E+11
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY
         EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               dichl
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.900E-01
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.900E-01
 Kd Aquifer (ml/g):              7.600E-03
 Risk/Dose Conversion Factor:    7.000E+00
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    6.9315E-13
Leach Rate Constant (1/y):                2.8490E-02
Initial Pore Water Conc (Ci or mg/m**3):  3.1033E-03
Solubility Limited Mass (mg):             3.2224E+11
Unsaturated Retardation Factor:           1.9060E+00
Mean Unsaturated Transit Time (y):        1.0846E+03
Leading Edge Arrival Time (y):            8.4820E+01
Aquifer Retardation Factor:               1.316E+00
Minimum Peak Window Time (y):             8.4943E+01
Maximum Peak Window Time (y):             1.3285E+03
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):             3.699E-08
Time of Peak (y):                         9.7796E+02
Concentrations Averaged Between:       9.6296E+02 and  9.9296E+02 years
Average Concentration (mg/m**3):          3.698E-08
Maximum Dose:                             5.283E-09
Maximum Allowable Inventory (mg):         1.893E+08
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               meth
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
```

```
 Kd Source (ml/g):               2.600E-02
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                2.600E-02
 Kd Aquifer (ml/g):              1.040E-03
 Risk/Dose Conversion Factor:    1.130E+01
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 4.9164E-02
Initial Pore Water Conc (Ci or mg/m**3):   5.3552E-03
Solubility Limited Mass (mg):              1.8673E+11
Unsaturated Retardation Factor:            1.1240E+00
Mean Unsaturated Transit Time (y):         6.3958E+02
Leading Edge Arrival Time (y):             5.0018E+01
Aquifer Retardation Factor:                1.043E+00
Minimum Peak Window Time (y):              5.0116E+01
Maximum Peak Window Time (y):              7.8101E+02
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):              6.273E-08
Time of Peak (y):                          5.7640E+02
Concentrations Averaged Between:       5.6140E+02 and  5.9140E+02 years
Average Concentration (mg/m**3):           6.270E-08
Maximum Dose:                              5.549E-09
Maximum Allowable Inventory (mg):          1.802E+08
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:              4-meth
 Half Life (y):                 1.000E+12
 Other Source Loss Rate (1/y):  0.000E+00
 Kd Source (ml/g):              0.000E+00
 Solubility Limit (mg/L):       1.000E+06
 Molecular Weight (mg/L):       9.990E+02
 Initial mass/activity:         1.000E+00
 Kd Unsat (ml/g):               0.000E+00
 Kd Aquifer (ml/g):             0.000E+00
 Risk/Dose Conversion Factor:   9.999E-01
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3):   6.0514E-03
Solubility Limited Mass (mg):              1.6525E+11
Unsaturated Retardation Factor:            1.0000E+00
Mean Unsaturated Transit Time (y):         5.6903E+02
Leading Edge Arrival Time (y):             4.4500E+01
Aquifer Retardation Factor:                1.000E+00
Minimum Peak Window Time (y):              4.4594E+01
Maximum Peak Window Time (y):              6.9422E+02
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):              7.051E-08
Time of Peak (y):                          5.1274E+02
Concentrations Averaged Between:       4.9774E+02 and  5.2774E+02 years
Average Concentration (mg/m**3):           7.047E-08
Maximum Dose:                              7.048E-08
Maximum Allowable Inventory (mg):          1.419E+07
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:              tol
 Half Life (y):                 1.000E+12
 Other Source Loss Rate (1/y):  0.000E+00
 Kd Source (ml/g):              1.000E+00
 Solubility Limit (mg/L):       1.000E+06
 Molecular Weight (mg/L):       9.990E+02
 Initial mass/activity:         1.000E+00
 Kd Unsat (ml/g):               1.000E+00
 Kd Aquifer (ml/g):             4.000E-02
 Risk/Dose Conversion Factor:   7.300E+03
-------------------------------------------------------------------------------
```

```
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  9.2593E-03
Initial Pore Water Conc (Ci or mg/m**3):    1.0086E-03
Solubility Limited Mass (mg):               9.9150E+11
Unsaturated Retardation Factor:             5.7687E+00
Mean Unsaturated Transit Time (y):          3.2826E+03
Leading Edge Arrival Time (y):              2.5671E+02
Aquifer Retardation Factor:                 2.661E+00
Minimum Peak Window Time (y):               2.5696E+02
Maximum Peak Window Time (y):               4.0323E+03
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):               1.222E-08
Time of Peak (y):                           2.9613E+03
Concentrations Averaged Between:       2.9463E+03 and  2.9763E+03 years
Average Concentration (mg/m**3):            1.222E-08
Maximum Dose:                               1.674E-12
Maximum Allowable Inventory (mg):           5.974E+11
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:                mp-xyl
 Half Life (y):                   1.000E+12
 Other Source Loss Rate (1/y):    0.000E+00
 Kd Source (ml/g):                3.000E+00
 Solubility Limit (mg/L):         1.000E+06
 Molecular Weight (mg/L):         9.990E+02
 Initial mass/activity:           1.000E+00
 Kd Unsat (ml/g):                 3.000E+00
 Kd Aquifer (ml/g):               1.200E-01
 Risk/Dose Conversion Factor:     7.300E+04
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  3.4722E-03
Initial Pore Water Conc (Ci or mg/m**3):    3.7821E-04
Solubility Limited Mass (mg):               2.6440E+12
Unsaturated Retardation Factor:             1.5306E+01
Mean Unsaturated Transit Time (y):          8.7096E+03
Leading Edge Arrival Time (y):              6.8112E+02
Aquifer Retardation Factor:                 5.982E+00
Minimum Peak Window Time (y):               6.8168E+02
Maximum Peak Window Time (y):               1.0708E+04
```

```
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):            4.605E-09
Time of Peak (y):                        7.8584E+03
Concentrations Averaged Between:       7.8434E+03 and  7.8734E+03 years
Average Concentration (mg/m**3):         4.605E-09
Maximum Dose:                            6.309E-14
Maximum Allowable Inventory (mg):        1.585E+13
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY
         EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               o-xyl
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               0.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                0.000E+00
 Kd Aquifer (ml/g):              0.000E+00
 Risk/Dose Conversion Factor:    7.300E+04
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3):   6.0514E-03
Solubility Limited Mass (mg):              1.6525E+11
Unsaturated Retardation Factor:            1.0000E+00
Mean Unsaturated Transit Time (y):         5.6903E+02
Leading Edge Arrival Time (y):             4.4500E+01
Aquifer Retardation Factor:                1.000E+00
Minimum Peak Window Time (y):              4.4594E+01
Maximum Peak Window Time (y):              6.9422E+02
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):            7.051E-08
Time of Peak (y):                        5.1274E+02
Concentrations Averaged Between:       4.9774E+02 and  5.2774E+02 years
Average Concentration (mg/m**3):         7.047E-08
Maximum Dose:                            9.653E-13
Maximum Allowable Inventory (mg):        1.036E+12
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY
         EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               styr
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               0.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                0.000E+00
 Kd Aquifer (ml/g):              0.000E+00
 Risk/Dose Conversion Factor:    7.300E+03
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3):   6.0514E-03
Solubility Limited Mass (mg):              1.6525E+11
Unsaturated Retardation Factor:            1.0000E+00
Mean Unsaturated Transit Time (y):         5.6903E+02
Leading Edge Arrival Time (y):             4.4500E+01
Aquifer Retardation Factor:                1.000E+00
Minimum Peak Window Time (y):              4.4594E+01
Maximum Peak Window Time (y):              6.9422E+02
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
```

```
      Peak Concentration (mg/m**3):            7.051E-08
      Time of Peak (y):                        5.1274E+02
      Concentrations Averaged Between:       4.9774E+02 and  5.2774E+02 years
      Average Concentration (mg/m**3):         7.047E-08
      Maximum Dose:                            9.653E-12
      Maximum Allowable Inventory (mg):        1.036E+11
Execution Time (Seconds):    0
```

GWSCREEN Input Deck – Non-Radionuclides Set #2

```
Nonrad 2 - CPP-603 - 2004 simulations for EE/CA
4 3 1 1 1                                    (Card 2) imode,itype,idisp,kflag,idil
1 1 2 1 2                                 (Card 3) imodel,isolve,isolveu,imoist,imoistu
6 15 0.01                                    (Card 4) jstart jmax eps
70. 2.555E+04 2.0 350.  30.  1.0          (Card 5) bw,at,wi,ef,ed,dlim
0.   0.                                       (Card 6) x0,y0
42.9  21.4  0.010                              (Card 7) l,w,perc
0.6  1.5                                  (Card 8b) thicks, rhos, (source term values)
0.30                                         (Card 8c) thetas (source term mc)
22.7   1.359  2.92                             (Card 9) depth,rhou,axu
$ NOTE: The values of depth and axu are the ucode calibrated values
$ van Genuchten parameters from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
1.066 1.523  21.13 0.487 0.142                (Card 9b) alphau nu ksatu porsu thetaru
$use calib values for ax and az ay=0.2ax and az=1.16e-3ax as stated in the MEPAS Manual
3.31 0.2  1.163E-3   76.  15.             (Card 10) ax,ay,az,b,z(well screen thickness)
$ Aqui dens and porosity from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
$ --- Darcy velocity based on an assumed pore vel of ~ 1 m/d in EDF-ER-275
21.9  0.06  2.491                              (Card 11) u,phi,rhoa
1                                               (Card 12a) nrecept
121.45   0.                                  (Card 12b x y)
15                                  (Card 12) ncontam
$  ------------------------ Aluminum ------------------ 1
0 250. 250. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'alumi'  1.e12 10.    3.65e4        (card14b) cname thalf kda dcf
$  ------------------------ Arsenic----------- 1
0   3.   3. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'arsen'  1.e12 0.12   5.67e-2       (card14b) cname thalf kda dcf
$  ------------------------ barium------------ 1
0  50.  50. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'bar'  1.e12 2.       2.56e+03      (card14b) cname thalf kda dcf
$  ------------------------ beryllium--------- 1
0 250. 250. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'beryl'  1.e12 10.    1.98E-02      (card14b) cname thalf kda dcf
$  ------------------------ cadmium----------- 1
0  6.   6. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'cadmi'  1.e12 0.24   3.65E+01      (card14b) cname thalf kda dcf
$  ------------------------ chloride     -------- 1
0   0.   0. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'chlor'  1.e12 0.     2.5E+05       (card14b) cname thalf kda dcf
$  ------------------------ chromium ------------------ 1
0   1.2 1.2 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'chrom'  1.e12 0.048  1.83E+02      (card14b) cname thalf kda dcf
$  ------------------------ lead ----------------- 1
0 100. 100. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'lead'  1.e12 4.      1.5E+01       (card14b) cname thalf kda dcf
$  ------------------------ mercury ------------------ 1
0  100. 100. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'mercu'  1.e12 4.     3.65          (card14b) cname thalf kda dcf
$  ------------------------ nickel ------------------ 1
0 100. 100. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'nicke' 1.e12 4.      7.3E+02       (card14b) cname thalf kda dcf
$  ------------------------ selenium ------------------ 1
0   4.   4. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'selen'  1.e12 0.16   1.83E+02      (card14b) cname thalf kda dcf
$  ------------------------ silicon----------------- 1
0  0.0  0.0 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'silic'  1.e12 0.0    0.99999       (card14b) cname thalf kda dcf
$  ------------------------ silver----------------- 1
0  90.  90. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'silve'  1.e12 3.6    1.83E+02      (card14b) cname thalf kda dcf
$  ------------------------ uranium ------------------ 1
0 6.  6. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'urani'  1.e12 0.24   1.1E+02      (card14b) cname thalf kda dcf
$  ------------------------ zinc ----------------- 1
0  16.  16. 999 1.0 1.0 1.0E6 0.0   (card14a) nprog kds kdu zmw qi rmi sl other
'zinc'  1.e12 0.64    1.1E+04       (card14b) cname thalf kda dcf
```

GWSCREEN Output – Non-Radionuclides Set #2

```
 ************************************************
 *     This output was produced by the model:   *
 *                  GWSCREEN                    *
 *                Version 2.5a                  *
 *    A semi-analytical model for the assessment *
 *    of the groundwater pathway from the leaching *
 *    of surficial and buried contamination and  *
 *  release of contaminants from percolation ponds *
 *                  08/26/2003                  *
 *                Arthur S. Rood                *
 *         Idaho National Engineering and       *
 *            Environmental Laboratory          *
 *                  PO Box 1625                 *
 *             Idaho Falls, Idaho 83415         *
 ************************************************
```


OUTPUT FILE NAME: u-soil-nrad2.out
INPUT FILE NAME: u-soil-nrad2.par
Title: Nonrad 2 - CPP-603 - 2004 simulations for EE/CA

Model Run Options

IMODE Contaminant Type and Impacts:	4
ITYPE (1) Vert Avg (2) 3D Point (3) 3d Avg:	3
IDISP (0) Fixed Dispersivity (1-3) Spatially Varying:	1
KFLAG (1) Max Conc (2) Conc vs Time (3) Grid Output:	1
IDIL (1) No dilution factor (2) Include Dilution Factor:	1
IMOIST Source Moisture Content Option:	1
IMOISTU Unsaturated Moisture Content Option:	2
IMODEL (1) Surface/Burried Src (2) Pond (3) Usr Def:	1
ISOLVE (1) Gaussian Quarature (2) Simpsons Rule: (Aquifer)	1
ISOLVEU (1) Gaussian Quarature (2) Simpsons Rule: (Unsat Zone)	2

JSTART: 6
JMAX : 15
EPS : 1.000E-02
Health Effects: Ratio of groundwater concentration to MCL
Output mass/activity units: mg
Output concentration units: mg/m**3
Dose/Risk Conversion Units: mg/m**3
Output health effects units: Ratio of Cp/Cmcl
Cp = Peak groundwater concentration, Cmcl = Maximum contaminant limit

Exposure Parameters

Body Mass (kg):	70.	Averaging Time (days):	25550.
Water Ingestion (L/d):	2.000E+00	Exposure Freq (day/year):	3.500E+02
Exposure Duration (y):	3.000E+01	Limiting Dose:	1.000E+00

Site Parameters

X Coordinate:	0.000E+00	Y Coordinate:	0.000E+00
Source Length (m):	4.290E+01	Source Width (m):	2.140E+01
Percolation Rate (m/y):	1.000E-02		
Source Thickness (m):	6.000E-01	Src Bulk Density (g/cc):	1.500E+00
Source Moisture Content:	3.000E-01		

Unsaturated Zone Parameters

Unsat Zone Thickness (m):	2.270E+01	Unsat Bulk Density:	1.359E+00
Unsat Alpha (1/m):	1.066E+00	Unsat n:	1.523E+00
Saturated K in Unsat (m/y):	2.113E+01	Porosity of Unsat Zone:	4.870E-01
Unsat Residual Moisture:	1.420E-01	Unsat Dispersivity (m):	2.920E+00

```
-------------------------------------------------------------------------------
Aquifer Zone Parameters
-------------------------------------------------------------------------------
Transverse/Longitud Ratio:   2.000E-01  Vertical/Longitud Ratio:    1.163E-03
Aquifer Thickness (m):       7.600E+01  Well Screen Thickness (m):  1.500E+01
Darcy Velocity (m/y):        2.190E+01  Aquifer Porosity:           6.000E-02
Bulk Density (g/cc):         2.491E+00
-------------------------------------------------------------------------------
Calculated Flow Parameters
-------------------------------------------------------------------------------
Percolation Water Flux (m3/y):  9.1806E+00
Unsaturated Moisture Content:   2.8499E-01
Unsat Pore Velocity (m/y):      3.5089E-02
Aquifer Pore Velocity (m/y):    3.6500E+02
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               alumi
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               2.500E+02
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                2.500E+02
 Kd Aquifer (ml/g):              1.000E+01
 Risk/Dose Conversion Factor:    3.650E+04
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  4.4409E-05
Initial Pore Water Conc (Ci or mg/m**3):  4.8373E-06
Solubility Limited Mass (mg):               2.0673E+14
Unsaturated Retardation Factor:             1.1932E+03
Mean Unsaturated Transit Time (y):          6.7895E+05
Leading Edge Arrival Time (y):              5.3096E+04
Aquifer Retardation Factor:                 4.162E+02
Minimum Peak Window Time (y):               5.3135E+04
Maximum Peak Window Time (y):               8.3521E+05
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):             5.908E-11
Time of Peak (y):                         6.1265E+05
Concentrations Averaged Between:       6.1263E+05 and  6.1266E+05 years
Average Concentration (mg/m**3):          5.908E-11
Maximum Dose:                             1.619E-15
Maximum Allowable Inventory (mg):         6.178E+14
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY
         EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               arsen
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               3.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                3.000E+00
 Kd Aquifer (ml/g):              1.200E-01
 Risk/Dose Conversion Factor:    5.670E-02
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  3.4722E-03
Initial Pore Water Conc (Ci or mg/m**3):  3.7821E-04
Solubility Limited Mass (mg):               2.6440E+12
Unsaturated Retardation Factor:             1.5306E+01
Mean Unsaturated Transit Time (y):          8.7096E+03
Leading Edge Arrival Time (y):              6.8112E+02
Aquifer Retardation Factor:                 5.982E+00
Minimum Peak Window Time (y):               6.8168E+02
Maximum Peak Window Time (y):               1.0708E+04
```

```
------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):            4.605E-09
Time of Peak (y):                        7.8584E+03
Concentrations Averaged Between:       7.8434E+03 and  7.8734E+03 years
Average Concentration (mg/m**3):         4.605E-09
Maximum Dose:                            8.122E-08
Maximum Allowable Inventory (mg):        1.231E+07
------------------------------------------------------------------------------
Contaminant Data
------------------------------------------------------------------------------
 Contaminant Name:               bar
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               5.000E+01
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                5.000E+01
 Kd Aquifer (ml/g):              2.000E+00
 Risk/Dose Conversion Factor:    2.560E+03
------------------------------------------------------------------------------
Calculated Contaminant Values
------------------------------------------------------------------------------
Decay Constants (1/y):                    6.9315E-13
Leach Rate Constant (1/y):                2.2134E-04
Initial Pore Water Conc (Ci or mg/m**3):  2.4109E-05
Solubility Limited Mass (mg):             4.1478E+13
Unsaturated Retardation Factor:           2.3943E+02
Mean Unsaturated Transit Time (y):        1.3625E+05
Leading Edge Arrival Time (y):            1.0655E+04
Aquifer Retardation Factor:               8.403E+01
Minimum Peak Window Time (y):             1.0663E+04
Maximum Peak Window Time (y):             1.6760E+05
------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):            2.944E-10
Time of Peak (y):                        1.2294E+05
Concentrations Averaged Between:       1.2292E+05 and  1.2295E+05 years
Average Concentration (mg/m**3):         2.944E-10
Maximum Dose:                            1.150E-13
Maximum Allowable Inventory (mg):        8.696E+12
------------------------------------------------------------------------------
Contaminant Data
------------------------------------------------------------------------------
 Contaminant Name:               beryl
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               2.500E+02
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                2.500E+02
 Kd Aquifer (ml/g):              1.000E+01
 Risk/Dose Conversion Factor:    1.980E-02
------------------------------------------------------------------------------
Calculated Contaminant Values
------------------------------------------------------------------------------
Decay Constants (1/y):                    6.9315E-13
Leach Rate Constant (1/y):                4.4409E-05
Initial Pore Water Conc (Ci or mg/m**3):  4.8373E-06
Solubility Limited Mass (mg):             2.0673E+14
Unsaturated Retardation Factor:           1.1932E+03
Mean Unsaturated Transit Time (y):        6.7895E+05
Leading Edge Arrival Time (y):            5.3096E+04
Aquifer Retardation Factor:               4.162E+02
Minimum Peak Window Time (y):             5.3135E+04
Maximum Peak Window Time (y):             8.3521E+05
------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):            5.908E-11
Time of Peak (y):                        6.1265E+05
Concentrations Averaged Between:       6.1263E+05 and  6.1266E+05 years
Average Concentration (mg/m**3):         5.908E-11
```

```
Maximum Dose:                              2.984E-09
Maximum Allowable Inventory (mg):          3.352E+08
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:                 cadmi
 Half Life (y):                    1.000E+12
 Other Source Loss Rate (1/y):     0.000E+00
 Kd Source (ml/g):                 6.000E+00
 Solubility Limit (mg/L):          1.000E+06
 Molecular Weight (mg/L):          9.990E+02
 Initial mass/activity:            1.000E+00
 Kd Unsat (ml/g):                  6.000E+00
 Kd Aquifer (ml/g):                2.400E-01
 Risk/Dose Conversion Factor:      3.650E+01
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  1.7921E-03
Initial Pore Water Conc (Ci or mg/m**3):    1.9521E-04
Solubility Limited Mass (mg):               5.1228E+12
Unsaturated Retardation Factor:             2.9612E+01
Mean Unsaturated Transit Time (y):          1.6850E+04
Leading Edge Arrival Time (y):              1.3177E+03
Aquifer Retardation Factor:                 1.096E+01
Minimum Peak Window Time (y):               1.3188E+03
Maximum Peak Window Time (y):               2.0723E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):               2.380E-09
Time of Peak (y):                           1.5204E+04
Concentrations Averaged Between:         1.5189E+04 and  1.5219E+04 years
Average Concentration (mg/m**3):            2.380E-09
Maximum Dose:                               6.522E-11
Maximum Allowable Inventory (mg):           1.533E+10
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:                 chlor
 Half Life (y):                    1.000E+12
 Other Source Loss Rate (1/y):     0.000E+00
 Kd Source (ml/g):                 0.000E+00
 Solubility Limit (mg/L):          1.000E+06
 Molecular Weight (mg/L):          9.990E+02
 Initial mass/activity:            1.000E+00
 Kd Unsat (ml/g):                  0.000E+00
 Kd Aquifer (ml/g):                0.000E+00
 Risk/Dose Conversion Factor:      2.500E+05
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3):    6.0514E-03
Solubility Limited Mass (mg):               1.6525E+11
Unsaturated Retardation Factor:             1.0000E+00
Mean Unsaturated Transit Time (y):          5.6903E+02
Leading Edge Arrival Time (y):              4.4500E+01
Aquifer Retardation Factor:                 1.000E+00
Minimum Peak Window Time (y):               4.4594E+01
Maximum Peak Window Time (y):               6.9422E+02
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):               7.051E-08
Time of Peak (y):                           5.1274E+02
Concentrations Averaged Between:         4.9774E+02 and  5.2774E+02 years
Average Concentration (mg/m**3):            7.047E-08
Maximum Dose:                               2.819E-13
Maximum Allowable Inventory (mg):           3.548E+12
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY
         EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT
```

```
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               chrom
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.200E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.200E+00
 Kd Aquifer (ml/g):              4.800E-02
 Risk/Dose Conversion Factor:    1.830E+02
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 7.9365E-03
Initial Pore Water Conc (Ci or mg/m**3):   8.6449E-04
Solubility Limited Mass (mg):              1.1568E+12
Unsaturated Retardation Factor:            6.7224E+00
Mean Unsaturated Transit Time (y):         3.8253E+03
Leading Edge Arrival Time (y):             2.9915E+02
Aquifer Retardation Factor:                2.993E+00
Minimum Peak Window Time (y):              2.9943E+02
Maximum Peak Window Time (y):              4.6999E+03
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):              1.049E-08
Time of Peak (y):                          3.4510E+03
Concentrations Averaged Between:        3.4360E+03 and  3.4660E+03 years
Average Concentration (mg/m**3):           1.049E-08
Maximum Dose:                              5.730E-11
Maximum Allowable Inventory (mg):          1.745E+10
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               lead
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.000E+02
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.000E+02
 Kd Aquifer (ml/g):              4.000E+00
 Risk/Dose Conversion Factor:    1.500E+01
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 1.1089E-04
Initial Pore Water Conc (Ci or mg/m**3):   1.2079E-05
Solubility Limited Mass (mg):              8.2791E+13
Unsaturated Retardation Factor:            4.7787E+02
Mean Unsaturated Transit Time (y):         2.7192E+05
Leading Edge Arrival Time (y):             2.1265E+04
Aquifer Retardation Factor:                1.671E+02
Minimum Peak Window Time (y):              2.1281E+04
Maximum Peak Window Time (y):              3.3450E+05
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):              1.475E-10
Time of Peak (y):                          2.4537E+05
Concentrations Averaged Between:        2.4535E+05 and  2.4538E+05 years
Average Concentration (mg/m**3):           1.475E-10
Maximum Dose:                              9.834E-12
Maximum Allowable Inventory (mg):          1.017E+11
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               mercu
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.000E+02
 Solubility Limit (mg/L):        1.000E+06
```

```
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.000E+02
 Kd Aquifer (ml/g):              4.000E+00
 Risk/Dose Conversion Factor:    3.650E+00
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                    6.9315E-13
Leach Rate Constant (1/y):                1.1089E-04
Initial Pore Water Conc (Ci or mg/m**3):  1.2079E-05
Solubility Limited Mass (mg):             8.2791E+13
Unsaturated Retardation Factor:           4.7787E+02
Mean Unsaturated Transit Time (y):        2.7192E+05
Leading Edge Arrival Time (y):            2.1265E+04
Aquifer Retardation Factor:               1.671E+02
Minimum Peak Window Time (y):             2.1281E+04
Maximum Peak Window Time (y):             3.3450E+05
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):             1.475E-10
Time of Peak (y):                         2.4537E+05
Concentrations Averaged Between:       2.4535E+05 and  2.4538E+05 years
Average Concentration (mg/m**3):          1.475E-10
Maximum Dose:                             4.041E-11
Maximum Allowable Inventory (mg):         2.474E+10
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               nicke
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.000E+02
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.000E+02
 Kd Aquifer (ml/g):              4.000E+00
 Risk/Dose Conversion Factor:    7.300E+02
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                    6.9315E-13
Leach Rate Constant (1/y):                1.1089E-04
Initial Pore Water Conc (Ci or mg/m**3):  1.2079E-05
Solubility Limited Mass (mg):             8.2791E+13
Unsaturated Retardation Factor:           4.7787E+02
Mean Unsaturated Transit Time (y):        2.7192E+05
Leading Edge Arrival Time (y):            2.1265E+04
Aquifer Retardation Factor:               1.671E+02
Minimum Peak Window Time (y):             2.1281E+04
Maximum Peak Window Time (y):             3.3450E+05
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):             1.475E-10
Time of Peak (y):                         2.4537E+05
Concentrations Averaged Between:       2.4535E+05 and  2.4538E+05 years
Average Concentration (mg/m**3):          1.475E-10
Maximum Dose:                             2.021E-13
Maximum Allowable Inventory (mg):         4.949E+12
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               selen
 Half Life (y):                  1.000E+12
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               4.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.990E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                4.000E+00
 Kd Aquifer (ml/g):              1.600E-01
 Risk/Dose Conversion Factor:    1.830E+02
```

```
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  2.6455E-03
Initial Pore Water Conc (Ci or mg/m**3):    2.8816E-04
Solubility Limited Mass (mg):               3.4703E+12
Unsaturated Retardation Factor:             2.0075E+01
Mean Unsaturated Transit Time (y):          1.1423E+04
Leading Edge Arrival Time (y):              8.9333E+02
Aquifer Retardation Factor:                 7.643E+00
Minimum Peak Window Time (y):               8.9405E+02
Maximum Peak Window Time (y):               1.4046E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):               3.511E-09
Time of Peak (y):                           1.0307E+04
Concentrations Averaged Between:         1.0292E+04 and  1.0322E+04 years
Average Concentration (mg/m**3):            3.511E-09
Maximum Dose:                               1.919E-11
Maximum Allowable Inventory (mg):           5.212E+10
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:                 silic
 Half Life (y):                    1.000E+12
 Other Source Loss Rate (1/y):     0.000E+00
 Kd Source (ml/g):                 0.000E+00
 Solubility Limit (mg/L):          1.000E+06
 Molecular Weight (mg/L):          9.990E+02
 Initial mass/activity:            1.000E+00
 Kd Unsat (ml/g):                  0.000E+00
 Kd Aquifer (ml/g):                0.000E+00
 Risk/Dose Conversion Factor:      1.000E+00
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3):    6.0514E-03
Solubility Limited Mass (mg):               1.6525E+11
Unsaturated Retardation Factor:             1.0000E+00
Mean Unsaturated Transit Time (y):          5.6903E+02
Leading Edge Arrival Time (y):              4.4500E+01
Aquifer Retardation Factor:                 1.000E+00
Minimum Peak Window Time (y):               4.4594E+01
Maximum Peak Window Time (y):               6.9422E+02
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):               7.051E-08
Time of Peak (y):                           5.1274E+02
Concentrations Averaged Between:         4.9774E+02 and  5.2774E+02 years
Average Concentration (mg/m**3):            7.047E-08
Maximum Dose:                               7.047E-08
Maximum Allowable Inventory (mg):           1.419E+07
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:                 silve
 Half Life (y):                    1.000E+12
 Other Source Loss Rate (1/y):     0.000E+00
 Kd Source (ml/g):                 9.000E+01
 Solubility Limit (mg/L):          1.000E+06
 Molecular Weight (mg/L):          9.990E+02
 Initial mass/activity:            1.000E+00
 Kd Unsat (ml/g):                  9.000E+01
 Kd Aquifer (ml/g):                3.600E+00
 Risk/Dose Conversion Factor:      1.830E+02
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                      6.9315E-13
Leach Rate Constant (1/y):                  1.2318E-04
Initial Pore Water Conc (Ci or mg/m**3):    1.3418E-05
Solubility Limited Mass (mg):               7.4528E+13
Unsaturated Retardation Factor:             4.3018E+02
```

```
Mean Unsaturated Transit Time (y):         2.4479E+05
Leading Edge Arrival Time (y):             1.9143E+04
Aquifer Retardation Factor:                1.505E+02
Minimum Peak Window Time (y):              1.9157E+04
Maximum Peak Window Time (y):              3.0112E+05
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):              1.639E-10
Time of Peak (y):                          2.2088E+05
Concentrations Averaged Between:       2.2087E+05 and  2.2090E+05 years
Average Concentration (mg/m**3):           1.639E-10
Maximum Dose:                              8.954E-13
Maximum Allowable Inventory (mg):          1.117E+12
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:                urani
 Half Life (y):                   1.000E+12
 Other Source Loss Rate (1/y):    0.000E+00
 Kd Source (ml/g):                6.000E+00
 Solubility Limit (mg/L):         1.000E+06
 Molecular Weight (mg/L):         9.990E+02
 Initial mass/activity:           1.000E+00
 Kd Unsat (ml/g):                 6.000E+00
 Kd Aquifer (ml/g):               2.400E-01
 Risk/Dose Conversion Factor:     1.100E+02
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 1.7921E-03
Initial Pore Water Conc (Ci or mg/m**3):   1.9521E-04
Solubility Limited Mass (mg):              5.1228E+12
Unsaturated Retardation Factor:            2.9612E+01
Mean Unsaturated Transit Time (y):         1.6850E+04
Leading Edge Arrival Time (y):             1.3177E+03
Aquifer Retardation Factor:                1.096E+01
Minimum Peak Window Time (y):              1.3188E+03
Maximum Peak Window Time (y):              2.0723E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):              2.380E-09
Time of Peak (y):                          1.5204E+04
Concentrations Averaged Between:       1.5189E+04 and  1.5219E+04 years
Average Concentration (mg/m**3):           2.380E-09
Maximum Dose:                              2.164E-11
Maximum Allowable Inventory (mg):          4.621E+10
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:                zinc
 Half Life (y):                   1.000E+12
 Other Source Loss Rate (1/y):    0.000E+00
 Kd Source (ml/g):                1.600E+01
 Solubility Limit (mg/L):         1.000E+06
 Molecular Weight (mg/L):         9.990E+02
 Initial mass/activity:           1.000E+00
 Kd Unsat (ml/g):                 1.600E+01
 Kd Aquifer (ml/g):               6.400E-01
 Risk/Dose Conversion Factor:     1.100E+04
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                     6.9315E-13
Leach Rate Constant (1/y):                 6.8587E-04
Initial Pore Water Conc (Ci or mg/m**3):   7.4709E-05
Solubility Limited Mass (mg):              1.3385E+13
Unsaturated Retardation Factor:            7.7298E+01
Mean Unsaturated Transit Time (y):         4.3985E+04
Leading Edge Arrival Time (y):             3.4398E+03
```

```
Aquifer Retardation Factor:                2.757E+01
Minimum Peak Window Time (y):              3.4424E+03
Maximum Peak Window Time (y):              5.4103E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (mg/m**3):              9.119E-10
Time of Peak (y):                          3.9689E+04
Concentrations Averaged Between:        3.9674E+04 and  3.9704E+04 years
Average Concentration (mg/m**3):           9.119E-10
Maximum Dose:                              8.290E-14
Maximum Allowable Inventory (mg):          1.206E+13
Execution Time (Seconds):    1
```

GWSCREEN Input Deck – Radionuclides – Baseline Assuming Soil Source

```
CPP-603 - radionuclides - Soil source - Jan. 9, 2004
2 3 1 1 1                                   (Card 2) imode,itype,idisp,kflag,idil
1 1 2 1 2                                 (Card 3) imodel,isolve,isolveu,imoist,imoistu
6 15 0.01                                   (Card 4) jstart jmax eps
70. 2.555E+04 2.0 350.  30.  1.0E-6          (Card 5) bw,at,wi,ef,ed,dlim
0.   0.                                       (Card 6) x0,y0
42.9  21.4  0.010                              (Card 7) l,w,perc
0.6  1.5                                  (Card 8b) thicks, rhos, (source term values)
0.30                                        (Card 8c) thetas (source term mc)
22.7   1.359  2.92                          (Card 9) depth,rhou,axu
$ NOTE: The values of depth and axu are the ucode calibrated values
$ van Genuchten parameters from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
1.066 1.523  21.13 0.487 0.142                 (Card 9b) alphau nu ksatu porsu thetaru
$use calib values for ax and az ay=0.2ax and az=1.16e-3ax as stated in the MEPAS Manual
$but ax, ay, and az are ignored if idisp > 0.
3.31 0.2  1.163E-3   76.  15.             (Card 10) ax,ay,az,b,z(well screen thickness)
$ Aqui dens and porosity from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
$ --- Darcy velocity based on an assumed pore vel of ~ 1 m/d in EDF-ER-275
21.9  0.06  2.491                           (Card 11) u,phi,rhoa
1                                            (Card 12a) nrecept
121.45   0.                                (Card 12b x y)
11                                             (Card 14) ncontam
$  -----------------not used- Am-241 (Np) ------------------------ 1
3 340. 340. 237 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Am-241'   432. 13.6  3.28E+02           (card14b) cname thalf kda dcf
'Np-237'  2.140E+06  0.32  3.00E+02                (card14b) cname thalf kda dcf
'U-233'  1.592E+05  0.24  4.48E+01               (card14b) cname thalf kda dcf
'Th-229'  7.340E+03  4  3.56E+02                (card14b) cname thalf kda dcf
$  ------------------------ C-14 ----------------------- 2
0 0.1 0.1 14 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'C-14'  5.730E+03  0.004  1.03E+00                   (card14b) cname thalf kda dcf
$  ------------------------ I-129 ----------------------- 3
0 0.1 0.1  129 1. 0. 1.0E+06 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'I-129'  1.570E+07  0.004  1.84E+02                    (card14b) cname thalf kda dcf
$  ------------------------ Np-237 ----------------------- 5
2 8. 8. 237 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Np-237'  2.14E+06  0.32  3.00E+02                (card14b) cname thalf kda dcf
'U-233'  1.59E+05  0.24  4.48E+01                 (card14b) cname thalf kda dcf
'Th-229'  7.34E+03  4.  3.56E+02                 (card14b) cname thalf kda dcf
$  -----------------not used-- Pu-238 ------------------------ 6
4 140. 140.  238. 1.  0. 1.0E6 0.0   (Card 12a) nprog kds kdu zmw q0 rmi sl other
Pu-238 87.8 5.6  2.95E+02          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
U-234  2.45E5 0.24  4.44E+01          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Th-230 7.54E4 4.0   3.75E+01          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Ra-226 1.60E3 4.0   2.96E+02          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Pb-210 22.3   4.0   1.01E+03          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
$  ------------------------ Pu-239 ----------------------- 5
3 140. 140. 239 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Pu-239'  2.410E+04  5.6  3.16E+02                (card14b) cname thalf kda dcf
'U-235'  7.037E+08  0.24  4.70E+01                (card14b) cname thalf kda dcf
'Pa-231'  3.276E+04  22  1.49E+02                 (card14b) cname thalf kda dcf
'Ac-227'  2.177E+01  18  6.26E+02                 (card14b) cname thalf kda dcf
$  ------------------------ Pu-240 ----------------------- 6
 4 140. 140. 240 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Pu-240'  6.560E+03  5.6  3.15E+02                (card14b) cname thalf kda dcf
'U-236'  2.342E+07  0.24  4.21E+01                (card14b) cname thalf kda dcf
'Th-232'  1.410E+10  4  3.28E+01                 (card14b) cname thalf kda dcf
'Ra-228'  5.750E+00  4  2.48E+02                 (card14b) cname thalf kda dcf
'Th-228'  1.910E+00  4  2.31E+02                 (card14b) cname thalf kda dcf
$  ------------------------ Tc-99 ----------------------- 7
0 0.2 0.2 99 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Tc-99'  2.111E+05  0.008  1.40E+00                (card14b) cname thalf kda dcf
$  ------------------------ U-234 ----------------------- 8
3 6. 6. 234 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'U-234'  2.45E+05  0.24  4.44E+01                (card14b) cname thalf kda dcf
'Th-230'  7.54E+04  4  3.75E+01                  (card14b) cname thalf kda dcf
'Ra-226'  1.60E+03  4  2.96E+02                  (card14b) cname thalf kda dcf
'Pb-210'  2.23E+01  4  1.01E+03                  (card14b) cname thalf kda dcf
$  ------------------------ U-235 ----------------------- 9
2 6.   6. 235.  1. 0. 1.0E6 0.0   (Card 12a) nprog kds kdu zmw q0 rmi sl other
U-235  7.04E8 0.24  4.70E+01          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Pa-231 3.28E4 22.0  1.49E+02          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Ac-227 21.8   18.0  6.26E+02         (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
```

```
$  ------------------------ U-238 ----------------------- 9
4 6.  6. 238 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'U-238'  4.47E+09  0.24  6.20E+01                 (card14b) cname thalf kda dcf
'U-234'  2.45E+05  0.24  4.44E+01                 (card14b) cname thalf kda dcf
'Th-230'  7.54E+04  4  3.75E+01                   (card14b) cname thalf kda dcf
'Ra-226'  1.60E+03  4  2.96E+02                   (card14b) cname thalf kda dcf
'Pb-210'  2.23E+01  4  1.01E+03                   (card14b) cname thalf kda dcf
```

GWSCREEN Output – Radionuclides – Baseline, Assuming Soil Source

```
 ************************************************
 *                                              *
 *     This output was produced by the model:   *
 *                                              *
 *                   GWSCREEN                   *
 *                 Version 2.5a                 *
 *    A semi-analytical model for the assessment *
 *    of the groundwater pathway from the leaching *
 *    of surficial and buried contamination and  *
 *  release of contaminants from percolation ponds *
 *                  08/26/2003                  *
 *                Arthur S. Rood                *
 *         Idaho National Engineering and       *
 *            Environmental Laboratory          *
 *                  PO Box 1625                 *
 *             Idaho Falls, Idaho 83415         *
 ************************************************
=============================================================================
         ACKNOWLEDGEMENT OF GOVERNMENT SPONSORSHIP AND
                 LIMITATION OF LIABILITY

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Numerical Recipes, Cambridge University Press.
 ============================================================================

 OUTPUT FILE NAME: u-soil-rad.out
 INPUT FILE NAME: u-soil-rad.par
Title: CPP-603 - radionuclides - soil source - Jan. 9, 2004
-----------------------------------------------------------------------------
Model Run Options
-----------------------------------------------------------------------------
IMODE Contaminant Type and Impacts:                              2
ITYPE (1) Vert Avg (2) 3D Point (3) 3d Avg:                      3
IDISP (0) Fixed Dispersivity (1-3) Spatially Varying:            1
KFLAG (1) Max Conc (2) Conc vs Time (3) Grid Output:             1
IDIL (1) No dilution factor (2) Include Dilution Factor:         1
IMOIST Source Moisture Content Option:                           1
IMOISTU Unsaturated Moisture Content Option:                     2
IMODEL (1) Surface/Burried Src (2) Pond (3) Usr Def:             1
ISOLVE (1) Gaussian Quarature (2) Simpsons Rule: (Aquifer)       1
ISOLVEU (1) Gaussian Quarature (2) Simpsons Rule: (Unsat Zone)   2
JSTART:   6
JMAX  :  15
EPS   :  1.000E-02
Health Effects: Carcinogenic incidence risk for radionuclides
Output mass/activity units:   Ci
Output concentration units:   Ci/m**3
Dose/Risk Conversion Units:   1/Ci
Output health effects units:  carcinogenic risk
-----------------------------------------------------------------------------
Exposure Parameters
-----------------------------------------------------------------------------
Body Mass (kg):              70.       Averaging Time (days):      25550.
Water Ingestion (L/d):       2.000E+00 Exposure Freq (day/year):   3.500E+02
Exposure Duration (y):       3.000E+01 Limiting Dose:              1.000E-06
-----------------------------------------------------------------------------
Site Parameters
-----------------------------------------------------------------------------
X Coordinate:                0.000E+00  Y Coordinate:               0.000E+00
Source Length (m):           4.290E+01  Source Width (m):           2.140E+01
Percolation Rate (m/y):      1.000E-02
Source Thickness (m):        6.000E-01  Src Bulk Density (g/cc):    1.500E+00
Source Moisture Content:     3.000E-01
```

```
--------------------------------------------------------------------------------
Unsaturated Zone Parameters
--------------------------------------------------------------------------------
Unsat Zone Thickness (m):    2.270E+01  Unsat Bulk Density:         1.359E+00
Unsat Alpha (1/m):           1.066E+00  Unsat n:                   1.523E+00
Saturated K in Unsat (m/y):  2.113E+01  Porosity of Unsat Zone:     4.870E-01
Unsat Residual Moisture:     1.420E-01  Unsat Dispersivity (m):     2.920E+00
--------------------------------------------------------------------------------
Aquifer Zone Parameters
--------------------------------------------------------------------------------
Transverse/Longitud Ratio:   2.000E-01  Vertical/Longitud Ratio:    1.163E-03
Aquifer Thickness (m):       7.600E+01  Well Screen Thickness (m):  1.500E+01
Darcy Velocity (m/y):        2.190E+01  Aquifer Porosity:           6.000E-02
Bulk Density (g/cc):         2.491E+00
--------------------------------------------------------------------------------
Calculated Flow Parameters
--------------------------------------------------------------------------------
Percolation Water Flux (m3/y):  9.1806E+00
Unsaturated Moisture Content:   2.8499E-01
Unsat Pore Velocity (m/y):      3.5089E-02
Aquifer Pore Velocity (m/y):    3.6500E+02
Root not bracketed in subroutine UTT
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               Am-241
 Number of Progeny:              3
 Progeny Names:                 Np-237       U-233        Th-229
 Half Life (y):                  4.320E+02 2.140E+06 1.592E+05 7.340E+03
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               3.400E+02
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.370E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                3.400E+02
 Kd Aquifer (ml/g):              1.360E+01 3.200E-01 2.400E-01 4.000E+00
 Risk/Dose Conversion Factor:    3.280E+02 3.000E+02 4.480E+01 3.560E+02
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    1.6045E-03 3.2390E-07 4.3539E-06 9.4434E-05
Leach Rate Constant (1/y):                3.2661E-05
Initial Pore Water Conc (Ci or mg/m**3):  3.5576E-06
Solubility Limited Mass (mg):             2.8109E+14
Solubility Limited Act (Ci):              9.8230E+11
Unsaturated Retardation Factor:           1.6223E+03
Mean Unsaturated Transit Time (y):        3.5479E+04
Leading Edge Arrival Time (y):            3.5479E+04
Aquifer Retardation Factor:               5.656E+02 1.429E+01 1.096E+01 1.671E+02
Minimum Peak Window Time (y):             3.5530E+04
Maximum Peak Window Time (y):             2.4793E+05
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):           0.000E+00  0.000E+00  0.000E+00  0.000E+00
Time of Peak (y):                       2.4793E+05
Concentrations Averaged Between:       2.4792E+05 and  2.4795E+05 years
Average Concentration (Ci/m**3):        0.000E+00  0.000E+00  0.000E+00  0.000E+00
Maximum Dose:                           0.000E+00  0.000E+00  0.000E+00  0.000E+00
Total Dose (all members):                0.000E+00
Maximum allowable inventory is infinite
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               C-14
 Number of Progeny:              0
 Half Life (y):                  5.730E+03
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.000E-01
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        1.400E+01
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.000E-01
 Kd Aquifer (ml/g):              4.000E-03
 Risk/Dose Conversion Factor:    1.030E+00
```

```
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    1.2097E-04
Leach Rate Constant (1/y):                3.7037E-02
Initial Pore Water Conc (Ci or mg/m**3):  4.0343E-03
Solubility Limited Mass (mg):             2.4788E+11
Solubility Limited Act (Ci):              1.1056E+09
Unsaturated Retardation Factor:           1.4769E+00
Mean Unsaturated Transit Time (y):        8.1943E+02
Leading Edge Arrival Time (y):            6.5721E+01
Aquifer Retardation Factor:               1.166E+00
Minimum Peak Window Time (y):             6.5831E+01
Maximum Peak Window Time (y):             1.0071E+03
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (Ci/m**3):             4.360E-08
Time of Peak (y):                         7.4117E+02
Concentrations Averaged Between:       7.2617E+02 and  7.5617E+02 years
Average Concentration (Ci/m**3):          4.359E-08
Maximum Dose:                             9.428E-07
Maximum Allowable Inventory (Ci):         1.061E+00
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               I-129
 Number of Progeny:              0
 Half Life (y):                  1.570E+07
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.000E-01
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        1.290E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.000E-01
 Kd Aquifer (ml/g):              4.000E-03
 Risk/Dose Conversion Factor:    1.840E+02
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    4.4150E-08
Leach Rate Constant (1/y):                3.7037E-02
Initial Pore Water Conc (Ci or mg/m**3):  4.0343E-03
Solubility Limited Mass (mg):             2.4788E+11
Solubility Limited Act (Ci):              4.3790E+04
Unsaturated Retardation Factor:           1.4769E+00
Mean Unsaturated Transit Time (y):        8.4038E+02
Leading Edge Arrival Time (y):            6.5721E+01
Aquifer Retardation Factor:               1.166E+00
Minimum Peak Window Time (y):             6.5831E+01
Maximum Peak Window Time (y):             1.0280E+03
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (Ci/m**3):             4.774E-08
Time of Peak (y):                         7.5758E+02
Concentrations Averaged Between:       7.4258E+02 and  7.7258E+02 years
Average Concentration (Ci/m**3):          4.772E-08
Maximum Dose:                             1.844E-04
Maximum Allowable Inventory (Ci):         5.423E-03
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               Np-237
 Number of Progeny:              2
 Progeny Names:                 U-233        Th-229
 Half Life (y):                  2.140E+06 1.590E+05 7.340E+03
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               8.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.370E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                8.000E+00
 Kd Aquifer (ml/g):              3.200E-01 2.400E-01 4.000E+00
 Risk/Dose Conversion Factor:    3.000E+02 4.480E+01 3.560E+02
```

```
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    3.2390E-07 4.3594E-06 9.4434E-05
Leach Rate Constant (1/y):                1.3550E-03
Initial Pore Water Conc (Ci or mg/m**3):  1.4760E-04
Solubility Limited Mass (mg):             6.7753E+12
Solubility Limited Act (Ci):              4.7796E+06
Unsaturated Retardation Factor:           3.9149E+01
Mean Unsaturated Transit Time (y):        2.2236E+04
Leading Edge Arrival Time (y):            1.7422E+03
Aquifer Retardation Factor:               1.429E+01 1.096E+01 1.671E+02
Minimum Peak Window Time (y):             1.7435E+03
Maximum Peak Window Time (y):             2.7358E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):             1.789E-09  1.959E-10  7.172E-12
Time of Peak (y):                         2.0069E+04
Concentrations Averaged Between:       2.0054E+04 and  2.0084E+04 years
Average Concentration (Ci/m**3):          1.789E-09  1.959E-10  7.172E-12
Maximum Dose:                             1.127E-05  1.843E-07  5.362E-08
Total Dose (all members):                  1.151E-05
Maximum Allowable Inventory (Ci):         8.690E-02
Root not bracketed in subroutine UTT
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:              Pu-238
 Number of Progeny:             4
 Progeny Names:                U-234        Th-230       Ra-226       Pb-210
 Half Life (y):                 8.780E+01 2.450E+05 7.540E+04 1.600E+03 2.230E+01
 Other Source Loss Rate (1/y):  0.000E+00
 Kd Source (ml/g):              1.400E+02
 Solubility Limit (mg/L):       1.000E+06
 Molecular Weight (mg/L):       2.380E+02
 Initial mass/activity:         1.000E+00
 Kd Unsat (ml/g):               1.400E+02
 Kd Aquifer (ml/g):             5.600E+00 2.400E-01 4.000E+00 4.000E+00 4.000E+00
 Risk/Dose Conversion Factor:   2.950E+02 4.440E+01 3.750E+01 2.960E+02 1.010E+03
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    7.8946E-03 2.8292E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y):                7.9252E-05
Initial Pore Water Conc (Ci or mg/m**3):  8.6325E-06
Solubility Limited Mass (mg):             1.1584E+14
Solubility Limited Act (Ci):              1.9834E+12
Unsaturated Retardation Factor:           6.6861E+02
Mean Unsaturated Transit Time (y):        1.0284E+04
Leading Edge Arrival Time (y):            1.0284E+04
Aquifer Retardation Factor:               2.335E+02 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y):             1.0305E+04
Maximum Peak Window Time (y):             9.7836E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):             5.439E-80  3.722E-46  2.252E-48  1.774E-48  1.767E-48
Time of Peak (y):                         1.0490E+04
Concentrations Averaged Between:       1.0475E+04 and  1.0505E+04 years
Average Concentration (Ci/m**3):          5.438E-80  3.730E-46  2.257E-48  1.778E-48  1.771E-48
Maximum Dose:                             3.369E-76  3.478E-43  1.777E-45  1.105E-44  3.757E-44
Total Dose (all members):                  3.982E-43
Maximum Allowable Inventory (Ci):         2.511E+36
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY
         EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:              Pu-239
 Number of Progeny:             3
 Progeny Names:                U-235        Pa-231       Ac-227
 Half Life (y):                 2.410E+04 7.037E+08 3.276E+04 2.177E+01
 Other Source Loss Rate (1/y):  0.000E+00
```

```
 Kd Source (ml/g):              1.400E+02
 Solubility Limit (mg/L):       1.000E+06
 Molecular Weight (mg/L):       2.390E+02
 Initial mass/activity:         1.000E+00
 Kd Unsat (ml/g):               1.400E+02
 Kd Aquifer (ml/g):             5.600E+00 2.400E-01 2.200E+01 1.800E+01
 Risk/Dose Conversion Factor:   3.160E+02 4.700E+01 1.490E+02 6.260E+02
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                   2.8761E-05 9.8500E-10 2.1158E-05 3.1840E-02
Leach Rate Constant (1/y):               7.9252E-05
Initial Pore Water Conc (Ci or mg/m**3): 8.6325E-06
Solubility Limited Mass (mg):            1.1584E+14
Solubility Limited Act (Ci):             7.1958E+09
Unsaturated Retardation Factor:          6.6861E+02
Mean Unsaturated Transit Time (y):       1.5165E+05
Leading Edge Arrival Time (y):           2.9753E+04
Aquifer Retardation Factor:              2.335E+02 1.096E+01 9.144E+02 7.483E+02
Minimum Peak Window Time (y):            2.9775E+04
Maximum Peak Window Time (y):            2.3921E+05
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):           2.713E-13  1.507E-14  1.614E-16  1.972E-16
Time of Peak (y):                       1.5111E+05
Concentrations Averaged Between:       1.5109E+05 and  1.5112E+05 years
Average Concentration (Ci/m**3):        2.713E-13  1.507E-14  1.614E-16  1.972E-16
Maximum Dose:                           1.800E-09  1.488E-11  5.050E-13  2.592E-12
Total Dose (all members):                1.818E-09
Maximum Allowable Inventory (Ci):       5.499E+02
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:              Pu-240
 Number of Progeny:             4
 Progeny Names:                U-236        Th-232       Ra-228       Th-228
 Half Life (y):                 6.560E+03 2.342E+07 1.410E+10 5.750E+00 1.910E+00
 Other Source Loss Rate (1/y):  0.000E+00
 Kd Source (ml/g):              1.400E+02
 Solubility Limit (mg/L):       1.000E+06
 Molecular Weight (mg/L):       2.400E+02
 Initial mass/activity:         1.000E+00
 Kd Unsat (ml/g):               1.400E+02
 Kd Aquifer (ml/g):             5.600E+00 2.400E-01 4.000E+00 4.000E+00 4.000E+00
 Risk/Dose Conversion Factor:   3.150E+02 4.210E+01 3.280E+01 2.480E+02 2.310E+02
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                   1.0566E-04 2.9596E-08 4.9159E-11 1.2055E-01 3.6290E-01
Leach Rate Constant (1/y):               7.9252E-05
Initial Pore Water Conc (Ci or mg/m**3): 8.6325E-06
Solubility Limited Mass (mg):            1.1584E+14
Solubility Limited Act (Ci):             2.6325E+10
Unsaturated Retardation Factor:          6.6861E+02
Mean Unsaturated Transit Time (y):       8.5117E+04
Leading Edge Arrival Time (y):           2.9753E+04
Aquifer Retardation Factor:              2.335E+02 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y):            2.9775E+04
Maximum Peak Window Time (y):            1.7268E+05
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):           5.576E-17  3.275E-15  8.208E-22  8.207E-22  8.207E-22
Time of Peak (y):                       8.7045E+04
Concentrations Averaged Between:       8.7030E+04 and  8.7060E+04 years
Average Concentration (Ci/m**3):        5.576E-17  3.275E-15  8.208E-22  8.207E-22  8.207E-22
Maximum Dose:                           3.688E-13  2.896E-12  5.654E-19  4.274E-18  3.981E-18
Total Dose (all members):                3.265E-12
Maximum Allowable Inventory (Ci):       3.063E+05
```

```
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               Tc-99
 Number of Progeny:              0
 Half Life (y):                  2.111E+05
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               2.000E-01
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.900E+01
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                2.000E-01
 Kd Aquifer (ml/g):              8.000E-03
 Risk/Dose Conversion Factor:    1.400E+00
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    3.2835E-06
Leach Rate Constant (1/y):                2.7778E-02
Initial Pore Water Conc (Ci or mg/m**3):  3.0257E-03
Solubility Limited Mass (mg):             3.3050E+11
Solubility Limited Act (Ci):              5.6582E+06
Unsaturated Retardation Factor:           1.9537E+00
Mean Unsaturated Transit Time (y):        1.1107E+03
Leading Edge Arrival Time (y):            8.6942E+01
Aquifer Retardation Factor:               1.332E+00
Minimum Peak Window Time (y):             8.7067E+01
Maximum Peak Window Time (y):             1.3608E+03
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (Ci/m**3):             3.597E-08
Time of Peak (y):                         1.0016E+03
Concentrations Averaged Between:       9.8664E+02 and  1.0166E+03 years
Average Concentration (Ci/m**3):          3.596E-08
Maximum Dose:                             1.057E-06
Maximum Allowable Inventory (Ci):         9.458E-01
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               U-234
 Number of Progeny:              3
 Progeny Names:                 Th-230       Ra-226       Pb-210
 Half Life (y):                  2.450E+05 7.540E+04 1.600E+03 2.230E+01
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               6.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.340E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                6.000E+00
 Kd Aquifer (ml/g):              2.400E-01 4.000E+00 4.000E+00 4.000E+00
 Risk/Dose Conversion Factor:    4.440E+01 3.750E+01 2.960E+02 1.010E+03
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    2.8292E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y):                1.7921E-03
Initial Pore Water Conc (Ci or mg/m**3):  1.9521E-04
Solubility Limited Mass (mg):             5.1228E+12
Solubility Limited Act (Ci):              3.1971E+07
Unsaturated Retardation Factor:           2.9612E+01
Mean Unsaturated Transit Time (y):        1.6649E+04
Leading Edge Arrival Time (y):            1.3177E+03
Aquifer Retardation Factor:               1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y):             1.3188E+03
Maximum Peak Window Time (y):             2.0521E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):             2.281E-09  1.974E-11  1.691E-11  1.687E-11
Time of Peak (y):                         1.5047E+04
Concentrations Averaged Between:       1.5032E+04 and  1.5062E+04 years
Average Concentration (Ci/m**3):          2.281E-09  1.974E-11  1.691E-11  1.687E-11
Maximum Dose:                             2.127E-06  1.555E-08  1.051E-07  3.578E-07
Total Dose (all members):                 2.605E-06
Maximum Allowable Inventory (Ci):         3.839E-01
```

```
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               U-235
 Number of Progeny:              2
 Progeny Names:                 Pa-231       Ac-227
 Half Life (y):                  7.040E+08 3.280E+04 2.180E+01
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               6.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.350E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                6.000E+00
 Kd Aquifer (ml/g):              2.400E-01 2.200E+01 1.800E+01
 Risk/Dose Conversion Factor:    4.700E+01 1.490E+02 6.260E+02
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    9.8458E-10 2.1133E-05 3.1796E-02
Leach Rate Constant (1/y):                1.7921E-03
Initial Pore Water Conc (Ci or mg/m**3):  1.9521E-04
Solubility Limited Mass (mg):             5.1228E+12
Solubility Limited Act (Ci):              1.1079E+04
Unsaturated Retardation Factor:           2.9612E+01
Mean Unsaturated Transit Time (y):        1.6850E+04
Leading Edge Arrival Time (y):            1.3177E+03
Aquifer Retardation Factor:               1.096E+01 9.144E+02 7.483E+02
Minimum Peak Window Time (y):             1.3188E+03
Maximum Peak Window Time (y):             2.0722E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):            2.380E-09  7.844E-12  9.567E-12
Time of Peak (y):                        1.5204E+04
Concentrations Averaged Between:       1.5189E+04 and  1.5219E+04 years
Average Concentration (Ci/m**3):         2.380E-09  7.844E-12  9.567E-12
Maximum Dose:                            2.349E-06  2.454E-08  1.258E-07
Total Dose (all members):                 2.500E-06
Maximum Allowable Inventory (Ci):        4.000E-01
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               U-238
 Number of Progeny:              4
 Progeny Names:                 U-234        Th-230       Ra-226       Pb-210
 Half Life (y):                  4.470E+09 2.450E+05 7.540E+04 1.600E+03 2.230E+01
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               6.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.380E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                6.000E+00
 Kd Aquifer (ml/g):              2.400E-01 2.400E-01 4.000E+00 4.000E+00 4.000E+00
 Risk/Dose Conversion Factor:    6.200E+01 4.440E+01 3.750E+01 2.960E+02 1.010E+03
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    1.5507E-10 2.8292E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y):                1.7921E-03
Initial Pore Water Conc (Ci or mg/m**3):  1.9521E-04
Solubility Limited Mass (mg):             5.1228E+12
Solubility Limited Act (Ci):              1.7229E+03
Unsaturated Retardation Factor:           2.9612E+01
Mean Unsaturated Transit Time (y):        1.6850E+04
Leading Edge Arrival Time (y):            1.3177E+03
Aquifer Retardation Factor:               1.096E+01 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y):             1.3188E+03
Maximum Peak Window Time (y):             2.0723E+04
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):            2.380E-09  1.002E-10  4.420E-13  3.303E-13  3.288E-13
Time of Peak (y):                        1.5204E+04
Concentrations Averaged Between:       1.5189E+04 and  1.5219E+04 years
```

Average Concentration (Ci/m**3):	2.380E-09	1.002E-10	4.420E-13	3.303E-13	3.288E-13
Maximum Dose:	3.099E-06	9.345E-08	3.481E-10	2.053E-09	6.973E-09
Total Dose (all members):	3.202E-06				
Maximum Allowable Inventory (Ci):	3.123E-01				
Execution Time (Seconds): 5					

GWSCREEN Input Deck – Radionuclides – Grouted Source

```
CPP-603 - radionuclides - grouted source - Jan. 9, 2004
2 3 1 1 1                                   (Card 2) imode,itype,idisp,kflag,idil
1 1 2 1 2                                 (Card 3) imodel,isolve,isolveu,imoist,imoistu
6 15 0.01                                   (Card 4) jstart jmax eps
70. 2.555E+04 2.0 350.  30.  1.0E-6          (Card 5) bw,at,wi,ef,ed,dlim
0.   0.                                       (Card 6) x0,y0
42.9  21.4  0.010                              (Card 7) l,w,perc
0.6  1.5                                  (Card 8b) thicks, rhos, (source term values)
0.30                                        (Card 8c) thetas (source term mc)
22.7   1.359  2.92                          (Card 9) depth,rhou,axu
$ NOTE: The values of depth and axu are the ucode calibrated values
$ van Genuchten parameters from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
1.066 1.523  21.13 0.487 0.142                (Card 9b) alphau nu ksatu porsu thetaru
$use calib values for ax and az ay=0.2ax and az=1.16e-3ax as stated in the MEPAS Manual
$but ax, ay, and az are ignored if idisp > 0.
3.31 0.2  1.163E-3   76.  15.             (Card 10) ax,ay,az,b,z(well screen thickness)
$ Aqui dens and porosity from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
$ --- Darcy velocity based on an assumed pore vel of ~ 1 m/d in EDF-ER-275
21.9  0.06  2.491                           (Card 11) u,phi,rhoa
1                                            (Card 12a) nrecept
121.45   0.                                (Card 12b x y)
11                                           (Card 14) ncontam
$  --------------not used -Am-241 (Np) ------------------------ 1
3 5000. 340. 237 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Am-241'   432. 13.6  3.28E+02          (card14b) cname thalf kda dcf
'Np-237'  2.140E+06  0.32  3.00E+02                (card14b) cname thalf kda dcf
'U-233'  1.592E+05  0.24  4.48E+01               (card14b) cname thalf kda dcf
'Th-229'  7.340E+03  4  3.56E+02                (card14b) cname thalf kda dcf
$  ------------------------ C-14 ----------------------- 2
0 10. 0.1 14 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'C-14'  5.730E+03  0.004  1.03E+00                   (card14b) cname thalf kda dcf
$  ------------------------ I-129 ----------------------- 3
0 2.0 0.1  129 1. 0. 1.0E+06 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'I-129'  1.570E+07  0.004  1.84E+02                    (card14b) cname thalf kda dcf
$  ------------------------ Np-237 ----------------------- 5
2 5000. 8. 237 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Np-237'  2.14E+06  0.32  3.00E+02                (card14b) cname thalf kda dcf
'U-233'  1.59E+05  0.24  4.48E+01                (card14b) cname thalf kda dcf
'Th-229'  7.34E+03  4.  3.56E+02                 (card14b) cname thalf kda dcf
$  ---------------not used--- Pu-238 ------------------------ 6
4 5000. 140.  238. 1.  0. 1.0E6 0.0   (Card 12a) nprog kds kdu zmw q0 rmi sl other
Pu-238 87.8 5.6  2.95E+02          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
U-234  2.45E5 0.24  4.44E+01          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Th-230 7.54E4 4.0   3.75E+01          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Ra-226 1.60E3 4.0   2.96E+02          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Pb-210 22.3   4.0   1.01E+03          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
$  ------------------------ Pu-239 ----------------------- 5
3 5000. 140. 239 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Pu-239'  2.410E+04  5.6  3.16E+02                (card14b) cname thalf kda dcf
'U-235'  7.037E+08  0.24  4.70E+01                (card14b) cname thalf kda dcf
'Pa-231'  3.276E+04  22  1.49E+02                (card14b) cname thalf kda dcf
'Ac-227'  2.177E+01  18  6.26E+02                (card14b) cname thalf kda dcf
$  ------------------------ Pu-240 ----------------------- 6
 4 5000. 140. 240 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Pu-240'  6.560E+03  5.6  3.15E+02                (card14b) cname thalf kda dcf
'U-236'  2.342E+07  0.24  4.21E+01                (card14b) cname thalf kda dcf
'Th-232'  1.410E+10  4  3.28E+01                 (card14b) cname thalf kda dcf
'Ra-228'  5.750E+00  4  2.48E+02                 (card14b) cname thalf kda dcf
'Th-228'  1.910E+00  4  2.31E+02                 (card14b) cname thalf kda dcf
$  ------------------------ Tc-99 ----------------------- 7
0 1000. 0.2 99 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'Tc-99'  2.111E+05  0.008  1.40E+00                (card14b) cname thalf kda dcf
$  ------------------------ U-234 ----------------------- 8
3 2000. 6. 234 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'U-234'  2.45E+05  0.24  4.44E+01                (card14b) cname thalf kda dcf
'Th-230'  7.54E+04  4  3.75E+01                  (card14b) cname thalf kda dcf
'Ra-226'  1.60E+03  4  2.96E+02                  (card14b) cname thalf kda dcf
'Pb-210'  2.23E+01  4  1.01E+03                  (card14b) cname thalf kda dcf
$  ------------------------ U-235 ----------------------- 9
2 2000.   6. 235.  1. 0. 1.0E6 0.0   (Card 12a) nprog kds kdu zmw q0 rmi sl other
U-235  7.04E8 0.24  4.70E+01          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Pa-231 3.28E4 22.0  1.49E+02          (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Ac-227 21.8   18.0  6.26E+02         (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
```

```
$  ------------------------ U-238 ------------------------ 9
4 2000.  6. 238 1. 0. 1.E+6 0.   (card14a) nprog kds kdu zmw qi rmi sl other
'U-238'  4.47E+09  0.24  6.20E+01                (card14b) cname thalf kda dcf
'U-234'  2.45E+05  0.24  4.44E+01                (card14b) cname thalf kda dcf
'Th-230'  7.54E+04  4  3.75E+01                  (card14b) cname thalf kda dcf
'Ra-226'  1.60E+03  4  2.96E+02                  (card14b) cname thalf kda dcf
'Pb-210'  2.23E+01  4  1.01E+03                  (card14b) cname thalf kda dcf
```

GWSCREEN Output – Radionuclides – Grouted Source

```
  ************************************************
  *                                              *
  *     This output was produced by the model:   *
  *                                              *
  *                   GWSCREEN                   *
  *                 Version 2.5a                 *
  *    A semi-analytical model for the assessment*
  *    of the groundwater pathway from the leaching*
  *    of surficial and buried contamination and *
  *  release of contaminants from percolation ponds*
  *                 08/26/2003                   *
  *               Arthur S. Rood                 *
  *         Idaho National Engineering and       *
  *            Environmental Laboratory          *
  *                 PO Box 1625                  *
  *             Idaho Falls, Idaho 83415         *
  ************************************************
 ================================================================================
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  ==============================================================================

  OUTPUT FILE NAME: u-grt-rad.out
  INPUT FILE NAME: u-grt-rad.par
 Title: CPP-603 - radionuclides - grouted source - Jan. 9, 2004
 --------------------------------------------------------------------------------
 Model Run Options
 --------------------------------------------------------------------------------
 IMODE Contaminant Type and Impacts:                              2
 ITYPE (1) Vert Avg (2) 3D Point (3) 3d Avg:                      3
 IDISP (0) Fixed Dispersivity (1-3) Spatially Varying:            1
 KFLAG (1) Max Conc (2) Conc vs Time (3) Grid Output:             1
 IDIL (1) No dilution factor (2) Include Dilution Factor:         1
 IMOIST Source Moisture Content Option:                           1
 IMOISTU Unsaturated Moisture Content Option:                     2
 IMODEL (1) Surface/Burried Src (2) Pond (3) Usr Def:             1
 ISOLVE (1) Gaussian Quarature (2) Simpsons Rule: (Aquifer)       1
 ISOLVEU (1) Gaussian Quarature (2) Simpsons Rule: (Unsat Zone)   2
 JSTART:   6
 JMAX   :  15
 EPS    :  1.000E-02
 Health Effects: Carcinogenic incidence risk for radionuclides
 Output mass/activity units:   Ci
 Output concentration units:   Ci/m**3
 Dose/Risk Conversion Units:   1/Ci
 Output health effects units:  carcinogenic risk
 --------------------------------------------------------------------------------
 Exposure Parameters
 --------------------------------------------------------------------------------
 Body Mass (kg):              70.       Averaging Time (days):      25550.
 Water Ingestion (L/d):       2.000E+00 Exposure Freq (day/year):   3.500E+02
 Exposure Duration (y):       3.000E+01 Limiting Dose:              1.000E-06
 --------------------------------------------------------------------------------
 Site Parameters
 --------------------------------------------------------------------------------
 X Coordinate:                0.000E+00  Y Coordinate:               0.000E+00
 Source Length (m):           4.290E+01  Source Width (m):           2.140E+01
 Percolation Rate (m/y):      1.000E-02
 Source Thickness (m):        6.000E-01  Src Bulk Density (g/cc):    1.500E+00
 Source Moisture Content:     3.000E-01
```

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--------------------------------------------------------------------------------
Unsaturated Zone Parameters
--------------------------------------------------------------------------------
Unsat Zone Thickness (m):    2.270E+01  Unsat Bulk Density:         1.359E+00
Unsat Alpha (1/m):           1.066E+00  Unsat n:                   1.523E+00
Saturated K in Unsat (m/y):  2.113E+01  Porosity of Unsat Zone:     4.870E-01
Unsat Residual Moisture:     1.420E-01  Unsat Dispersivity (m):    2.920E+00
--------------------------------------------------------------------------------
Aquifer Zone Parameters
--------------------------------------------------------------------------------
Transverse/Longitud Ratio:   2.000E-01  Vertical/Longitud Ratio:   1.163E-03
Aquifer Thickness (m):       7.600E+01  Well Screen Thickness (m): 1.500E+01
Darcy Velocity (m/y):        2.190E+01  Aquifer Porosity:          6.000E-02
Bulk Density (g/cc):         2.491E+00
--------------------------------------------------------------------------------
Calculated Flow Parameters
--------------------------------------------------------------------------------
Percolation Water Flux (m3/y):  9.1806E+00
Unsaturated Moisture Content:   2.8499E-01
Unsat Pore Velocity (m/y):      3.5089E-02
Aquifer Pore Velocity (m/y):    3.6500E+02
Root not bracketed in subroutine UTT
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               Am-241
 Number of Progeny:              3
 Progeny Names:                 Np-237       U-233        Th-229
 Half Life (y):                  4.320E+02 2.140E+06 1.592E+05 7.340E+03
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               5.000E+03
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.370E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                3.400E+02
 Kd Aquifer (ml/g):              1.360E+01 3.200E-01 2.400E-01 4.000E+00
 Risk/Dose Conversion Factor:    3.280E+02 3.000E+02 4.480E+01 3.560E+02
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    1.6045E-03 3.2390E-07 4.3539E-06 9.4434E-05
Leach Rate Constant (1/y):                2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3):  2.4205E-07
Solubility Limited Mass (mg):             4.1314E+15
Solubility Limited Act (Ci):              1.4438E+13
Unsaturated Retardation Factor:           1.6223E+03
Mean Unsaturated Transit Time (y):        3.5479E+04
Leading Edge Arrival Time (y):            3.5479E+04
Aquifer Retardation Factor:               5.656E+02 1.429E+01 1.096E+01 1.671E+02
Minimum Peak Window Time (y):             3.5530E+04
Maximum Peak Window Time (y):             3.1550E+06
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):            0.000E+00  0.000E+00  0.000E+00  0.000E+00
Time of Peak (y):                        3.1550E+06
Concentrations Averaged Between:       3.1550E+06 and  3.1550E+06 years
Average Concentration (Ci/m**3):         0.000E+00  0.000E+00  0.000E+00  0.000E+00
Maximum Dose:                            0.000E+00  0.000E+00  0.000E+00  0.000E+00
Total Dose (all members):                 0.000E+00
Maximum allowable inventory is infinite
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               C-14
 Number of Progeny:              0
 Half Life (y):                  5.730E+03
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.000E+01
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        1.400E+01
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.000E-01
 Kd Aquifer (ml/g):              4.000E-03
 Risk/Dose Conversion Factor:    1.030E+00
```

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--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    1.2097E-04
Leach Rate Constant (1/y):                1.0893E-03
Initial Pore Water Conc (Ci or mg/m**3):  1.1866E-04
Solubility Limited Mass (mg):             8.4278E+12
Solubility Limited Act (Ci):              3.7589E+10
Unsaturated Retardation Factor:           1.4769E+00
Mean Unsaturated Transit Time (y):        8.1943E+02
Leading Edge Arrival Time (y):            6.5721E+01
Aquifer Retardation Factor:               1.166E+00
Minimum Peak Window Time (y):             6.5831E+01
Maximum Peak Window Time (y):             7.1830E+03
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (Ci/m**3):             2.097E-08
Time of Peak (y):                         1.2686E+03
Concentrations Averaged Between:       1.2536E+03 and  1.2836E+03 years
Average Concentration (Ci/m**3):          2.097E-08
Maximum Dose:                             4.535E-07
Maximum Allowable Inventory (Ci):         2.205E+00
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               I-129
 Number of Progeny:              0
 Half Life (y):                  1.570E+07
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               2.000E+00
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        1.290E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.000E-01
 Kd Aquifer (ml/g):              4.000E-03
 Risk/Dose Conversion Factor:    1.840E+02
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    4.4150E-08
Leach Rate Constant (1/y):                5.0505E-03
Initial Pore Water Conc (Ci or mg/m**3):  5.5013E-04
Solubility Limited Mass (mg):             1.8178E+12
Solubility Limited Act (Ci):              3.2113E+05
Unsaturated Retardation Factor:           1.4769E+00
Mean Unsaturated Transit Time (y):        8.4038E+02
Leading Edge Arrival Time (y):            6.5721E+01
Aquifer Retardation Factor:               1.166E+00
Minimum Peak Window Time (y):             6.5831E+01
Maximum Peak Window Time (y):             2.2133E+03
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (Ci/m**3):             4.220E-08
Time of Peak (y):                         9.4548E+02
Concentrations Averaged Between:       9.3048E+02 and  9.6048E+02 years
Average Concentration (Ci/m**3):          4.219E-08
Maximum Dose:                             1.630E-04
Maximum Allowable Inventory (Ci):         6.133E-03
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               Np-237
 Number of Progeny:              2
 Progeny Names:                 U-233        Th-229
 Half Life (y):                  2.140E+06 1.590E+05 7.340E+03
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               5.000E+03
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.370E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                8.000E+00
 Kd Aquifer (ml/g):              3.200E-01 2.400E-01 4.000E+00
 Risk/Dose Conversion Factor:    3.000E+02 4.480E+01 3.560E+02
```

```
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    3.2390E-07 4.3594E-06 9.4434E-05
Leach Rate Constant (1/y):                2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3):  2.4205E-07
Solubility Limited Mass (mg):             4.1314E+15
Solubility Limited Act (Ci):              2.9145E+09
Unsaturated Retardation Factor:           3.9149E+01
Mean Unsaturated Transit Time (y):        2.2236E+04
Leading Edge Arrival Time (y):            1.7422E+03
Aquifer Retardation Factor:               1.429E+01 1.096E+01 1.671E+02
Minimum Peak Window Time (y):             1.7435E+03
Maximum Peak Window Time (y):             3.1415E+06
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):             9.879E-11  3.163E-11  1.767E-12
Time of Peak (y):                         6.3950E+04
Concentrations Averaged Between:       6.3935E+04 and  6.3965E+04 years
Average Concentration (Ci/m**3):          9.879E-11  3.163E-11  1.767E-12
Maximum Dose:                             6.224E-07  2.976E-08  1.321E-08
Total Dose (all members):                  6.653E-07
Maximum Allowable Inventory (Ci):         1.503E+00
Root not bracketed in subroutine UTT
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:              Pu-238
 Number of Progeny:             4
 Progeny Names:                U-234        Th-230       Ra-226       Pb-210
 Half Life (y):                 8.780E+01 2.450E+05 7.540E+04 1.600E+03 2.230E+01
 Other Source Loss Rate (1/y):  0.000E+00
 Kd Source (ml/g):              5.000E+03
 Solubility Limit (mg/L):       1.000E+06
 Molecular Weight (mg/L):       2.380E+02
 Initial mass/activity:         1.000E+00
 Kd Unsat (ml/g):               1.400E+02
 Kd Aquifer (ml/g):             5.600E+00 2.400E-01 4.000E+00 4.000E+00 4.000E+00
 Risk/Dose Conversion Factor:   2.950E+02 4.440E+01 3.750E+01 2.960E+02 1.010E+03
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    7.8946E-03 2.8292E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y):                2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3):  2.4205E-07
Solubility Limited Mass (mg):             4.1314E+15
Solubility Limited Act (Ci):              7.0739E+13
Unsaturated Retardation Factor:           6.6861E+02
Mean Unsaturated Transit Time (y):        1.0284E+04
Leading Edge Arrival Time (y):            1.0284E+04
Aquifer Retardation Factor:               2.335E+02 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y):             1.0305E+04
Maximum Peak Window Time (y):             3.1297E+06
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):             0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00
Time of Peak (y):                         3.1296E+06
Concentrations Averaged Between:       3.1296E+06 and  3.1297E+06 years
Average Concentration (Ci/m**3):          0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00
Maximum Dose:                             0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00
Total Dose (all members):                  0.000E+00
Maximum allowable inventory is infinite
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:              Pu-239
 Number of Progeny:             3
 Progeny Names:                U-235        Pa-231       Ac-227
 Half Life (y):                 2.410E+04 7.037E+08 3.276E+04 2.177E+01
 Other Source Loss Rate (1/y):  0.000E+00
 Kd Source (ml/g):              5.000E+03
 Solubility Limit (mg/L):       1.000E+06
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 Molecular Weight (mg/L):        2.390E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.400E+02
 Kd Aquifer (ml/g):              5.600E+00 2.400E-01 2.200E+01 1.800E+01
 Risk/Dose Conversion Factor:    3.160E+02 4.700E+01 1.490E+02 6.260E+02
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                   2.8761E-05 9.8500E-10 2.1158E-05 3.1840E-02
Leach Rate Constant (1/y):               2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3):  2.4205E-07
Solubility Limited Mass (mg):            4.1314E+15
Solubility Limited Act (Ci):             2.5664E+11
Unsaturated Retardation Factor:          6.6861E+02
Mean Unsaturated Transit Time (y):       1.5165E+05
Leading Edge Arrival Time (y):           2.9753E+04
Aquifer Retardation Factor:              2.335E+02 1.096E+01 9.144E+02 7.483E+02
Minimum Peak Window Time (y):            2.9775E+04
Maximum Peak Window Time (y):            3.2710E+06
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):            2.255E-14  2.212E-15  2.454E-17  2.998E-17
Time of Peak (y):                        1.7068E+05
Concentrations Averaged Between:       1.7066E+05 and  1.7069E+05 years
Average Concentration (Ci/m**3):         2.255E-14  2.212E-15  2.454E-17  2.998E-17
Maximum Dose:                            1.497E-10  2.183E-12  7.678E-14  3.942E-13
Total Dose (all members):                 1.523E-10
Maximum Allowable Inventory (Ci):        6.565E+03
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               Pu-240
 Number of Progeny:              4
 Progeny Names:                 U-236        Th-232       Ra-228       Th-228
 Half Life (y):                  6.560E+03 2.342E+07 1.410E+10 5.750E+00 1.910E+00
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               5.000E+03
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.400E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                1.400E+02
 Kd Aquifer (ml/g):              5.600E+00 2.400E-01 4.000E+00 4.000E+00 4.000E+00
 Risk/Dose Conversion Factor:    3.150E+02 4.210E+01 3.280E+01 2.480E+02 2.310E+02
-------------------------------------------------------------------------------
Calculated Contaminant Values
-------------------------------------------------------------------------------
Decay Constants (1/y):                   1.0566E-04 2.9596E-08 4.9159E-11 1.2055E-01 3.6290E-01
Leach Rate Constant (1/y):               2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3):  2.4205E-07
Solubility Limited Mass (mg):            4.1314E+15
Solubility Limited Act (Ci):             9.3889E+11
Unsaturated Retardation Factor:          6.6861E+02
Mean Unsaturated Transit Time (y):       8.5117E+04
Leading Edge Arrival Time (y):           2.9753E+04
Aquifer Retardation Factor:              2.335E+02 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y):            2.9775E+04
Maximum Peak Window Time (y):            3.2045E+06
-------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
-------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):            2.523E-18  2.107E-16  5.508E-23  5.508E-23  5.508E-23
Time of Peak (y):                        9.0379E+04
Concentrations Averaged Between:       9.0364E+04 and  9.0394E+04 years
Average Concentration (Ci/m**3):         2.523E-18  2.107E-16  5.508E-23  5.508E-23  5.508E-23
Maximum Dose:                            1.669E-14  1.863E-13  3.794E-20  2.868E-19  2.672E-19
Total Dose (all members):                 2.030E-13
Maximum Allowable Inventory (Ci):        4.926E+06
-------------------------------------------------------------------------------
Contaminant Data
-------------------------------------------------------------------------------
 Contaminant Name:               Tc-99
 Number of Progeny:              0
 Half Life (y):                  2.111E+05
```

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 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               1.000E+03
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        9.900E+01
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                2.000E-01
 Kd Aquifer (ml/g):              8.000E-03
 Risk/Dose Conversion Factor:    1.400E+00
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                     3.2835E-06
Leach Rate Constant (1/y):                 1.1109E-05
Initial Pore Water Conc (Ci or mg/m**3):   1.2100E-06
Solubility Limited Mass (mg):              8.2642E+14
Solubility Limited Act (Ci):               1.4148E+10
Unsaturated Retardation Factor:            1.9537E+00
Mean Unsaturated Transit Time (y):         1.1107E+03
Leading Edge Arrival Time (y):             8.6942E+01
Aquifer Retardation Factor:                1.332E+00
Minimum Peak Window Time (y):              8.7067E+01
Maximum Peak Window Time (y):              6.2507E+05
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
Peak Concentration (Ci/m**3):             5.359E-10
Time of Peak (y):                         3.9566E+03
Concentrations Averaged Between:       3.9416E+03 and  3.9716E+03 years
Average Concentration (Ci/m**3):          5.359E-10
Maximum Dose:                             1.575E-08
Maximum Allowable Inventory (Ci):         6.347E+01
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:              U-234
 Number of Progeny:             3
 Progeny Names:                Th-230       Ra-226       Pb-210
 Half Life (y):                 2.450E+05 7.540E+04 1.600E+03 2.230E+01
 Other Source Loss Rate (1/y):  0.000E+00
 Kd Source (ml/g):              2.000E+03
 Solubility Limit (mg/L):       1.000E+06
 Molecular Weight (mg/L):       2.340E+02
 Initial mass/activity:         1.000E+00
 Kd Unsat (ml/g):               6.000E+00
 Kd Aquifer (ml/g):             2.400E-01 4.000E+00 4.000E+00 4.000E+00
 Risk/Dose Conversion Factor:   4.440E+01 3.750E+01 2.960E+02 1.010E+03
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                     2.8292E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y):                 5.5550E-06
Initial Pore Water Conc (Ci or mg/m**3):   6.0508E-07
Solubility Limited Mass (mg):              1.6527E+15
Solubility Limited Act (Ci):               1.0314E+10
Unsaturated Retardation Factor:            2.9612E+01
Mean Unsaturated Transit Time (y):         1.6649E+04
Leading Edge Arrival Time (y):             1.3177E+03
Aquifer Retardation Factor:                1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y):              1.3188E+03
Maximum Peak Window Time (y):              1.2644E+06
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):             2.093E-10  4.461E-12  4.258E-12  4.255E-12
Time of Peak (y):                         4.0011E+04
Concentrations Averaged Between:       3.9996E+04 and  4.0026E+04 years
Average Concentration (Ci/m**3):          2.093E-10  4.461E-12  4.258E-12  4.255E-12
Maximum Dose:                             1.952E-07  3.513E-09  2.647E-08  9.025E-08
Total Dose (all members):                  3.154E-07
Maximum Allowable Inventory (Ci):         3.170E+00
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:              U-235
 Number of Progeny:             2
 Progeny Names:                Pa-231       Ac-227
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 Half Life (y):                  7.040E+08 3.280E+04 2.180E+01
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               2.000E+03
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.350E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                6.000E+00
 Kd Aquifer (ml/g):              2.400E-01 2.200E+01 1.800E+01
 Risk/Dose Conversion Factor:    4.700E+01 1.490E+02 6.260E+02
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    9.8458E-10 2.1133E-05 3.1796E-02
Leach Rate Constant (1/y):                5.5550E-06
Initial Pore Water Conc (Ci or mg/m**3):  6.0508E-07
Solubility Limited Mass (mg):             1.6527E+15
Solubility Limited Act (Ci):              3.5742E+06
Unsaturated Retardation Factor:           2.9612E+01
Mean Unsaturated Transit Time (y):        1.6850E+04
Leading Edge Arrival Time (y):            1.3177E+03
Aquifer Retardation Factor:               1.096E+01 9.144E+02 7.483E+02
Minimum Peak Window Time (y):             1.3188E+03
Maximum Peak Window Time (y):             1.2646E+06
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):             2.357E-10  1.713E-12  2.092E-12
Time of Peak (y):                         4.4084E+04
Concentrations Averaged Between:       4.4069E+04 and  4.4099E+04 years
Average Concentration (Ci/m**3):          2.357E-10  1.713E-12  2.092E-12
Maximum Dose:                             2.326E-07  5.359E-09  2.750E-08
Total Dose (all members):                  2.655E-07
Maximum Allowable Inventory (Ci):         3.767E+00
--------------------------------------------------------------------------------
Contaminant Data
--------------------------------------------------------------------------------
 Contaminant Name:               U-238
 Number of Progeny:              4
 Progeny Names:                 U-234        Th-230       Ra-226       Pb-210
 Half Life (y):                  4.470E+09 2.450E+05 7.540E+04 1.600E+03 2.230E+01
 Other Source Loss Rate (1/y):   0.000E+00
 Kd Source (ml/g):               2.000E+03
 Solubility Limit (mg/L):        1.000E+06
 Molecular Weight (mg/L):        2.380E+02
 Initial mass/activity:          1.000E+00
 Kd Unsat (ml/g):                6.000E+00
 Kd Aquifer (ml/g):              2.400E-01 2.400E-01 4.000E+00 4.000E+00 4.000E+00
 Risk/Dose Conversion Factor:    6.200E+01 4.440E+01 3.750E+01 2.960E+02 1.010E+03
--------------------------------------------------------------------------------
Calculated Contaminant Values
--------------------------------------------------------------------------------
Decay Constants (1/y):                    1.5507E-10 2.8292E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y):                5.5550E-06
Initial Pore Water Conc (Ci or mg/m**3):  6.0508E-07
Solubility Limited Mass (mg):             1.6527E+15
Solubility Limited Act (Ci):              5.5582E+05
Unsaturated Retardation Factor:           2.9612E+01
Mean Unsaturated Transit Time (y):        1.6850E+04
Leading Edge Arrival Time (y):            1.3177E+03
Aquifer Retardation Factor:               1.096E+01 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y):             1.3188E+03
Maximum Peak Window Time (y):             1.2646E+06
--------------------------------------------------------------------------------
Results for Receptor X =  1.21450E+02 Y = 0.00000E+00
--------------------------------------------------------------------------------
X Dispersion Coeff (m2/y):  3.8461E+03 Y Dispersion Coeff (m2/y):  7.6922E+02
 NOTE: Concentrations and Doses Reported in Order of the Decay Chain
 NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3):             2.357E-10  2.764E-11  3.288E-13  2.985E-13  2.981E-13
Time of Peak (y):                         4.4086E+04
Concentrations Averaged Between:       4.4071E+04 and  4.4101E+04 years
Average Concentration (Ci/m**3):          2.357E-10  2.764E-11  3.288E-13  2.985E-13  2.981E-13
Maximum Dose:                             3.069E-07  2.577E-08  2.589E-10  1.856E-09  6.323E-09
Total Dose (all members):                  3.411E-07
Maximum Allowable Inventory (Ci):         2.932E+00
Execution Time (Seconds):    5
```